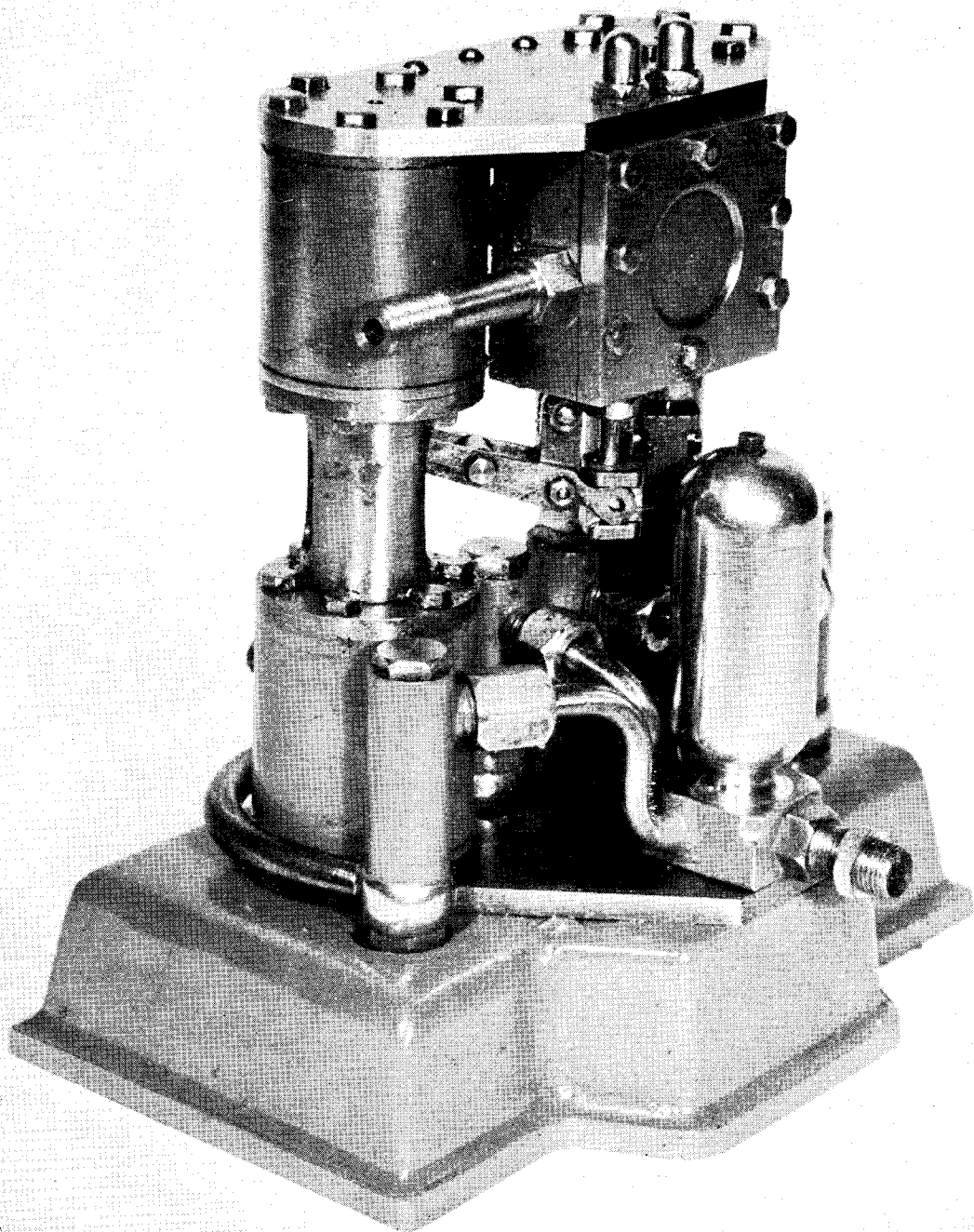


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# THE MODEL ENGINEER



# The MODEL ENGINEER

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28TH JUNE 1951



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## SMOKE RINGS

### Our Cover Picture

● IN OUR issue for April 12th last, we printed a letter from our old friend Mr. E. W. Fraser, of Luton, who described how he had built a miniature twin-cylinder pump. He liked the design by Mr. J. I. Austen-Walton, published six months earlier, but departed slightly from the original instructions, partly because he was not making the pump primarily for the purpose for which Mr. Austen-Walton intended it, but for the purpose of making something a little out of the ordinary.

At our request, Mr. Fraser recently brought the pump to our offices for us to see; we liked it very much, and we had it photographed; one of the pictures is reproduced on the cover of this issue, and we think that our readers will agree that Mr. Fraser has produced a pleasing little job which is as realistic as it is successful. To make something just for the love of making it is typical of the majority of model engineers.

### Can Anyone Help?

● DR. A. P. THURSTON, M.B.E., D.Sc., is endeavouring to help his friend, Mr. Frank Nixon, of Rolls Royce Ltd., to compile a biography of Francis Thompson, of Ashover, who built the Newcomen engine which is in the Science Museum. Any details of the life and work of Francis Thompson, and especially a portrait of him, would be welcome, and there is just a possibility that some reader of the "M.E."

may know of the existence of suitable information.

It is known that Francis Thompson was employed in 1791 at the Askerthorpe Colliery, Derbyshire, to erect the atmospheric engine there; this engine was subsequently taken down and re-erected at the Pentrich Colliery, near Ripley, in 1841, and some particulars are to be found in the *Transactions of Mining Engineering*, Vol. 52, 1917, pages 396-445. Also, if a portrait of Francis Thompson happens to exist, it almost certainly belongs to a time before photography was invented and is probably in the possession of some descendant or friend; so any information about living relatives would be of value.

If, by any chance, any reader is in possession of information or relics of Thompson, he is invited to write to Dr. Thurston at Bank Chambers, 329, High Holborn, London, W.C.1.

### Another "M.E." Exhibition Prize

● WE ARE pleased to announce that our popular contributors "Duplex" have offered a prize of £10, to be awarded to the best tool made from any of their descriptions and drawings which have been published in THE MODEL ENGINEER. There is still time to enter for this prize, and any reader who would care to do so should obtain an entry form, without delay, from the Exhibition Manager, Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2.

### M.-V. Model-making Section

● WE ARE glad to learn of a proposal to establish a model-making section at the works of Metropolitan-Vickers, Trafford Park, Manchester, in order to provide a hobby and to give some attractive occupation to retired members of the Long Service Association of the firm, who may find that time hangs heavily on their hands.

There is already a workshop and enough machine and hand tools to begin with.

The formation of the section is in the hands of a committee under the chairmanship of Mr. A. N. Howarth. Any retired member who may inadvertently not have been notified and is interested, should communicate with him at L.S.A. M.V. works, Trafford Park.

A wellwisher has sent a number of volumes of THE MODEL ENGINEER, and it is hoped that, from those members who are attracted to the scheme a number may be found who have a flair for model making and to begin by classifying woodworkers and metalworkers, so that each can be put to the sort of work they prefer.

In this way, it may be possible to arrange things by selecting a model of which the construction involves both woodwork and metalwork, so that more than one individual can help to build it.

To set out deliberately to provide a hobby for the encouragement and occupation of those who have retired from professional duties is a grand idea, and we wish it well.

### Keighley Progress

● ANOTHER SESSION of lectures of the Keighley and District M.E. Society has now terminated and the committee would again like to thank all concerned. Two excellent film shows were due to British Railways and the Ministry of Information.

Amos Barber brought to Keighley his model of a Corliss engine. It was, in fact, better described as a precision instrument. He gets better as the years go by. Douglas Miller really got down to model engineering in his talk with the aid of some very good drawings. As president of the Brighouse Society he has given this society a great deal of help and encouragement. Dr. Fletcher, of the Barnoldswick Society, brought his tug boat *Chieftain*, the championship winner in London in 1949, and shook everyone with its beautiful workmanship. Mr. Dan Hollings and Mr. Bamforth of the Bradford Society, brought two 7½-in. gauge locomotives in a trailer behind Mr. Hollings's car. It was rather a shock to find that Mr. Hollings's dock shunter (silver medal, 1948, London) had the fire lit! It was lit in Bradford before leaving. That was an evening to be remembered. Both the demonstration of "jacked up" running of the shunter and the workmanship of both models coupled with some very wise words from Dan Hollings were very helpful.

There was an annual dinner in March, and the society was 12 months old on May 9th; it feels very proud of itself and all that it has achieved.

The 52 members will have a chance of celebrating the formation of the society on July 7th next for a week when a Festival exhibition,

sponsored by the Keighley Borough Council, will be held in conjunction with the Arts and Crafts School of Keighley Technical College. This promises to be a very good show. Mr. Douglas Miller and Dr. Fletcher have consented to be the judges. The society has been entertained by Bradford and Huddersfield and has endeavoured to return their kindness. A panel of models in support of the Spenborough Society will be sent from Keighley when they hold their exhibition.

Will secretaries please note that the Keighley Society secretary is now Mr. Alan Hornby, c/o John Knox & Co., Silsden, Yorks., to which address all communications should be sent.

### The Human Factor in Industry

● WE WOULD like to call attention to an exhibition organised under the auspices of the Ministry of Labour and National Service. It is being held in the Safety, Health and Welfare Museum, Horseferry Road, Westminster, S.W.1, and will remain open until September 29th; the hours are 10 a.m. to 6 p.m. daily, except Sundays, and admission is free.

It covers every subject concerned with the question of manpower in industry, and parties from factories, industrial associations, technical institutions and the like can be conducted round on direct application at the museum.

### Turbine Locomotive No. 46202

● BUILT IN 1935 by the former L.M.S., locomotive No. 46202, which was experimentally fitted with a Lysholm-Smith Ljungstrom turbine, is to be converted to the normal reciprocating type. It has now run nearly 440,000 miles since construction and sufficient knowledge of the capabilities of this method of propulsion have been obtained over the years the locomotive has been in service.

A serious failure affecting the transmission took place last year, and in view of the cost which would be incurred in repairing this damage and effecting other replacements, it is now felt that it would be economically sound to take the opportunity of converting it to an orthodox 4-6-2 design.

### News from Southport

● THE SOUTHPORT Model and Engineering Club will be holding its fourth annual exhibition at Chapel Street Congregational Hall, Southport, from August 13th to 18th next. It will be open from 6 p.m. to 10 p.m. on the first day, and from 10 a.m. to 10 p.m. on each successive day. Entry forms and information can be obtained from the hon. secretary, Mr. T. Nelson, 41, Hawkshead Street, Southport. The closing date for entries is July 16th next.

We learn that the society has been fortunate enough to acquire a new workshop; it is 50 ft. by 20 ft., giving plenty of room for everyone. Any members of other clubs who may be visiting Southport will find a hearty welcome awaiting them if they will make their presence known.

# A 1.6 c.c. Petrol Engine

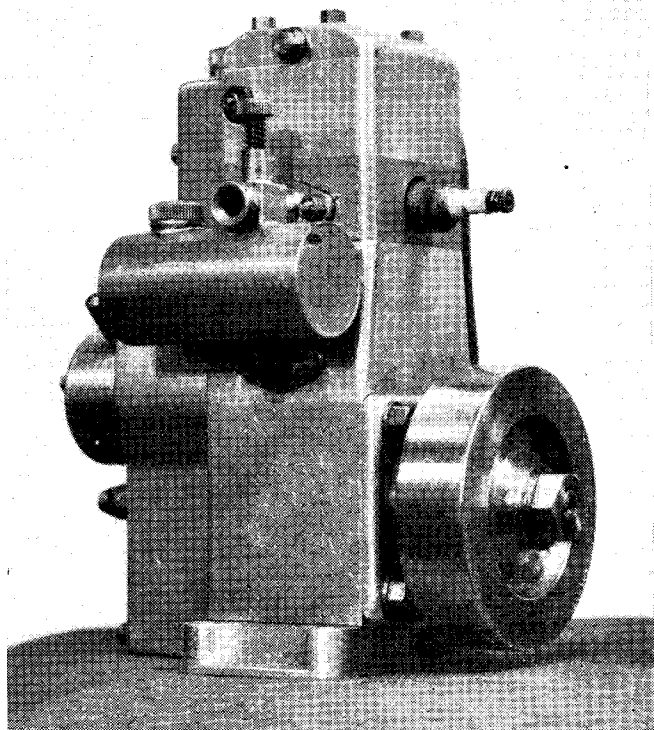
by M. Hollick

JUDGING by the articles which appear from time to time in *THE MODEL ENGINEER*, the majority of model maniacs who design and build petrol engines, do so with the idea of using their productions to power some future model. These amateur designers usually seem to favour single-cylinder air-cooled engines—frequently of the two-stroke type, and it would appear that those who are in a position to judge are not often willing to abandon simplicity in the design of an engine required to do a job of work.

In the case of very small capacity engines of, say, under 2 c.c. per cylinder, this striving after simplicity reaches its zenith, in the many tiny, so-called "diesel" engines which are produced. While such engines produce excellent results, regarded simply as a power plant, they inevitably lack appeal, to those who are interested in engines as an end in themselves, rather than a means to an end. Perhaps I am alone in assuming that a model engine may be an end, in itself, but one of the results of this attitude was this small engine. It was built to drive nothing in particular, being simply a small stationary engine.

The engine has a bore and stroke of  $\frac{1}{2}$  in. which gives a swept capacity of about 1.6 c.c. It is of the overhead valve, 4-stroke type and is water cooled; and in view of the reasons (or would it be more correct to say lack of reasons?) for which it was built, little effort was made to keep down the weight. No castings were used, all the components being machined from chunks of metal. The fact that the majority of these chunks were aluminium alloy, was simply because it was a suitable material, pleasant to machine, and is unconnected with any desire to reduce weight.

A wet cylinder liner of cast-iron is fitted, the piston being built up from dural with a 3 per cent. nickel steel skirt. The gudgeon-pin was made from a  $\frac{3}{32}$  in. diameter needle roller, and the dural con-rod is not bushed at either end, but the big-end is split to permit assembly with



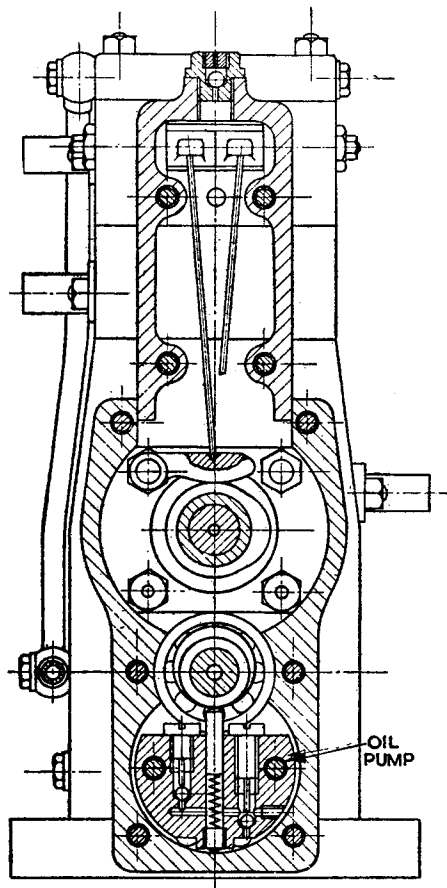
the crankshaft. The latter was also made of 3 per cent. nickel steel and is in one piece. It is supported in two small ball-races at the flywheel end, and in one ball-race at the timing case end.

The timing case contains the oil pump, of the plunger type ( $\frac{3}{32}$  in. bore  $\times$   $\frac{1}{16}$  in. stroke), which is actuated by a cam on the crankshaft. The lubrication is of the wet sump type and the pump is partially below the surface of the oil. The oil is forced through drillings to the stationary spindle on which the cams and their gear rotate; and through external pipes to the overhead valve gear and the crankshaft. Oil is fed into the end of the crankshaft (which is drilled through to the crankpin) and this arrangement avoids the necessity of forcing oil in against centrifugal force, the flow being simply along the crankshaft and out to the crank-pin, via the longitudinal and radial holes. The big-end of the con-rod has a small radial hole, which registers with that in the crank-pin, at one point, during rotation, to provide adequate cylinder lubrication. The use of a positive displacement type of pump, and no relief-valve may at first sight appear to be asking for trouble, but no great pressure can be built up, for the stub pipe which supplies oil to the crankshaft is intentionally very slack in the hole into which it fits, and also the only restriction to flow on the feed to the overhead gear is the size of the feed holes in the cover.

Beyond the oil pump cam, on the crankshaft is the smaller timing gear, and this meshes with

the camshaft gear; this drives three cams, two being of the normal type, to operate the valves, and one is a face cam to work the contact-breaker, enclosed in a small housing, outside the timing-case, which can be rotated to a small extent to vary the ignition timing.

The valve cams operate pivoted followers, which in turn actuate the push-rods, and thence the rockers and the valves. The push-rods started out in life as needles, but fulfil their present unusual function quite satisfactorily. The cams,



rockers and followers were made of mild-steel, case-hardened.

The valves were turned from the stem of a "Riley" car valve. The retaining of the spring caps on the valves presented a bit of a problem, as it was not desired to thread the valves, the stems of which are  $3/32$  in. diameter. The arrangement eventually adopted was that frequently used in full-sized engines—split cotters with tapered outside surfaces, which fit into a similarly tapered hole in the spring cap and also into a groove formed in the valve stem. As any feasible depth of groove would leave only about

$1/16$  in. diameter to the valve-stem at that point, the groove was made with a round form tool, instead of square. It has, therefore, no sharp corners to promote fracture; this, of course, necessitated forming the inner surface of the cotters, to correspond. Fortunately, my workshop is quite secluded, as those valve cotters caused many quite unprintable remarks, particularly when all was complete, and they were being fitted; for one saw fit to take a flight across the workshop. Rather surprisingly the tiny crumb of metal was found after a short while.

The valve guides are of phosphor-bronze and the head itself is composed of bronze with an upper portion of aluminium alloy, water passages being machined in both. The method of tappet adjustment is the fairly well-known, eccentrically mounted rocker spindle; while not being perfect, from a theoretical view-point, this system has been quite widely used in full-size practice, and is very convenient to fit in when space is restricted.

There is little else worth mentioning in the layout of the engine; and although it is incorrect in a few minor details, the drawing should serve to make all clear.

### Performance

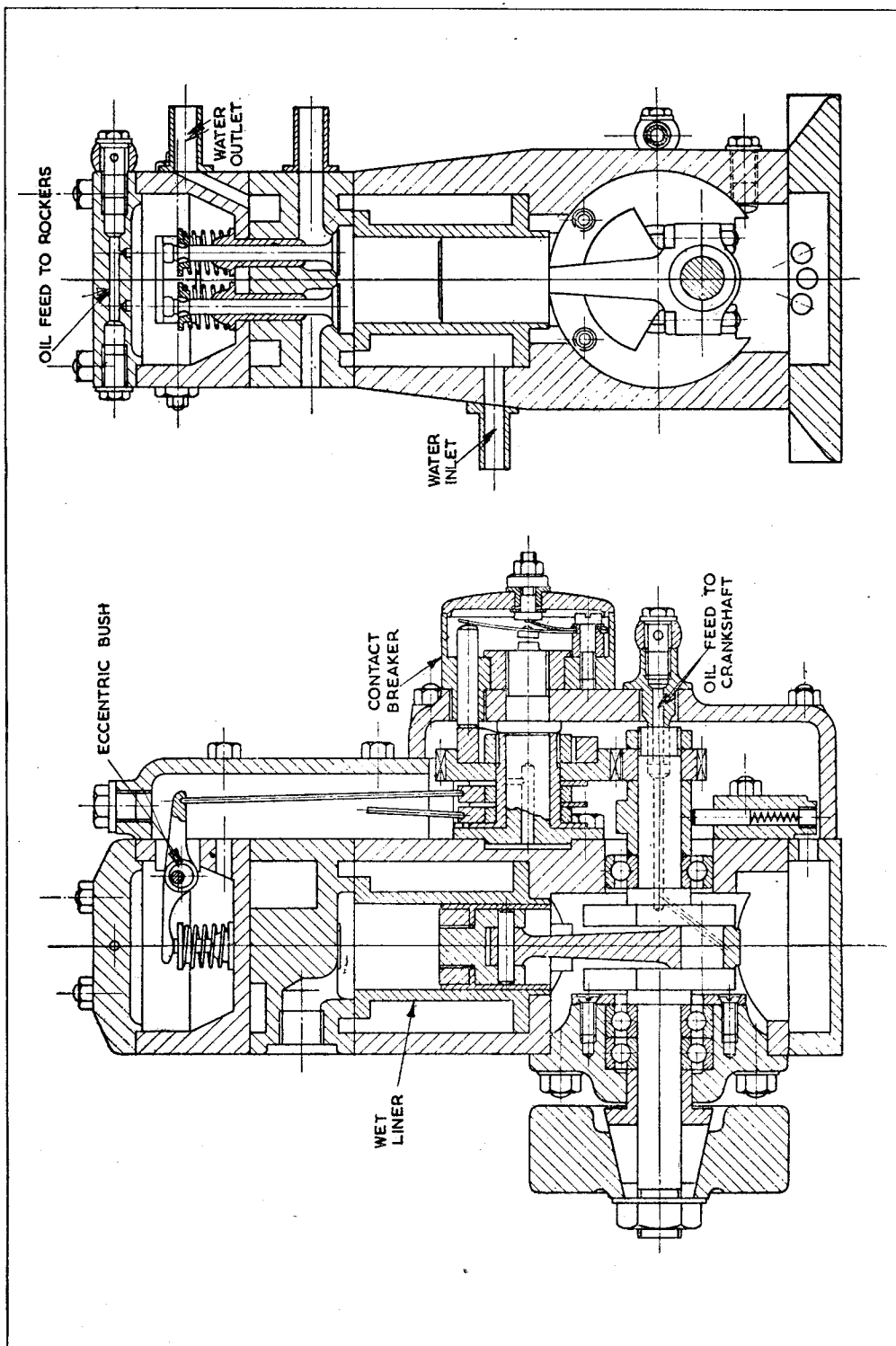
This tale would be incomplete, without a few words concerning the engine's performance.

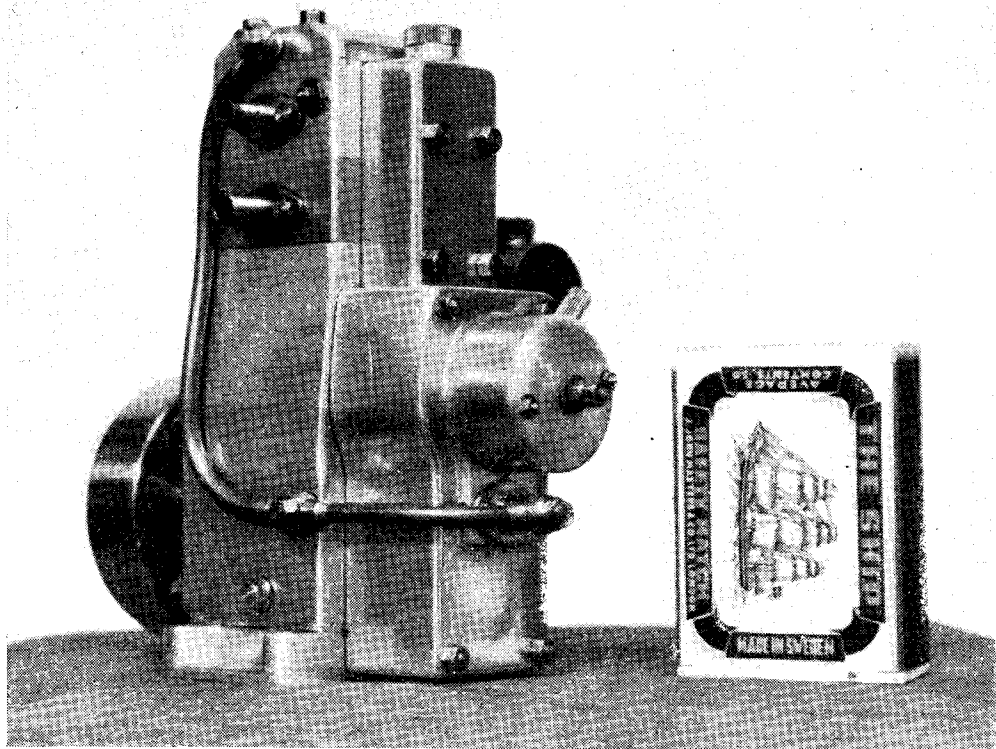
It would be nice to be able to say that after filling up with oil, water and petrol, connecting up an ignition circuit, and pulling the engine over a couple of times, it started. Alas! It was not like that at all—or rather only the filling up and connecting up—not the starting up. After trying in vain, for a long time, to get more than a few pops, I got to the stage of having to restrain myself from reaching for the hammer, to flatten the stupid thing. However, on the advice of some kind soul to whom I poured out my troubles, I put the thing away in a box, for about a month, and endeavoured to dismiss the matter from mind.

Suddenly, one week-end, I took it by surprise, and in a fine burst of energy, stripped it down, made and fitted two new cams, altered the shape of the combustion chamber, increased the compression ratio, fitted a larger flywheel, improved the breathing arrangements of the crankcase, lapped a tiny amount out of the cylinder and reassembled the lot. The engine was so astonished—it started within a matter of minutes. In retrospect, I think that the only critical alteration, was the lapping of the cylinder, the piston being originally slightly tight.

The engine has actually since run with the original flywheel; it is, however, still not too easy to start unless hot water is put into the cooling system; apparently the gumminess of the oil tends to stop things before the engine gets to the next power stroke. Possibly a thinner oil would help—I've not got around to trying it. This may sound strange to some, but I have known car engines, which, when cold were so stiff with thick oil that they would fire with insufficient force, to carry on to the next power stroke—a condition completely cured by using a thinner oil.

As can be seen by the photographs, all working





*A comparison of sizes*

parts of the engine are enclosed, in fact, when it is running, the only visible moving part is the flywheel, just the same as a simple little two-

stroke! What a waste of effort! Ample justification for those who say model makers are a queer lot! Or is it?

## Quartering Locomotive Cranks Without Tears!

by T. P. Arnott

**T**HOUGH I used every care and the two-bar jig, described by "L.B.S.C." some time ago, when pressing home the drivers on a  $2\frac{1}{2}$ -in. gauge six coupled "Live Steamer," I experienced slight binding on the trailing pair, so when it came to those on *Doris* I spent odd moments figuring out a "non-perhaps" set-up for this important moment! I make the axle stubs a wring fit in wheel bores so that they enter about quarter of the way, the remainder of stub being tapered 0.0005 in. and *dead smooth*. When pressed home, this gives a dead tight fit O.K. with no possibility of splitting the wheel boss.

Here's the way to quarter the cranks. First make little jigs of mild-steel a push fit in remainder of the hole in wheel, with (at *same* chuck setting, of course) about another  $\frac{1}{4}$  in. or so turned down to exactly crankpin diameter. Insert the jigs in

opposite wheels, mount the assembly on V-block on surface plate (plate glass is O.K.) and with a steel square on plate and blade against the two pins, take a reading over the opposite pair with D.T.I. mounted on the surface gauge. Adjust wheels till a "spot on" reading is obtained over the two pins. It is advisable to clamp the axle while taking the reading with the "clock," and make quite certain that the square is hard against the plate and the two pins while the clamp is tightened. The wheel cranks should, of course, first be set by eye at 90 deg. (watching that each lot is the same as preceding pair, so that one doesn't land up with one "out of step"! ) It's then up to your fine big press (if you're lucky) or vice, as in my case, to press the assemblies home without exercising any twisting torque. Mine came out O.K. Remove the little jig pins, of course, before pressing home.

# NOTES ON SCREW PROPELLERS

by G. W. Arthur-Brand

IT is not without a certain amount of trepidation that I present these notes on screw design to readers of THE MODEL ENGINEER. I wish to make it perfectly clear from the beginning that I know practically nothing about the design of the modern high efficiency surface screw, as used on racing model hydroplanes; but having been to several "M.E." Exhibitions, and seen a vast number of scale models of all types of engined craft, a few words on this important subject would not be amiss.

If we are to fully appreciate the development that has taken place since its first introduction, we must turn back through the pages of history, and reflect for a moment on what has gone before.

With the days of the paddle steamer still lingering in the immediate past, and indeed, with a number of these worthy stalwarts still performing serviceable duties in the ferry commissions of many countries, one is apt to look upon the propeller, or screw, as a comparatively modern invention.

So far back as 1752, Daniel Dernouilli invented a screw propeller which he proposed to drive by a steam engine, and in 1796, one John Fitch carried out fairly exhaustive experiments with a little screw-propelled steam boat on the Collect Pond in New York State.

In 1804, at Hoboken, Colonel John Stevens, an American, completed his 68 ft. steam boat in which was fitted a water-tube boiler, and a direct-acting high-pressure condensing engine with a 10 in. cylinder and a stroke of 2 ft., driving a 4-bladed screw. Stevens built another boat in 1805, introducing twin screws, and he was supported by a number of engineers in his belief that the screw would supersede the paddle as a means of marine propulsion; it was not, however, brought into general use until John Ericsson, a Swedish engineer resident in England, and a certain E. P. Smith, an English farmer, perfected and collaborated its introduction in Great Britain and America in the years 1836-1837. From this date the design and speed of marine engines commenced to undergo revolutionary changes, in spite of the perseverance of a number of firms to adapt to screw propulsion, the then distinct forms of paddel engines. As we all know, the screw is run at far greater r.p.m., than the paddle-wheel, but in view of the fact that engineers of those days regarded a piston speed of anything over 200 ft., per min. as dangerous, they sought to compromise in an effort to achieve the necessary speed by gearing.

Following closely on the commercial introduction of the screw as a means of propulsion for merchant vessels, the Admiralty were coaxed into building two ships of the same hull form and size, the *Rattler* and the *Alecto*. They were equipped with engines of equal power, but the former was fitted with a screw, and the latter, paddle wheels. As a result of competitive trials with these two vessels, and the great satisfaction

of the Admiralty with the comparative performance of the *Rattler*, the screw soon became generally adopted as a popular means of propulsion for ocean-going steam-ships. Following close on this move, the design of engines gradually crept forward, direct-acting high speed engines were introduced, and in a very few years, piston speeds of 700 ft. per min. were commonplace.

The early screw propellers though of the same basic design, nevertheless differed considerably from the modern editions seen on the latest trans-ocean liners. To the untrained eye, and indeed, to many an old hand, one propeller appears to be very much like another, except in extreme cases, where a complete departure from more or less standard form makes this obvious. The question is often asked: "What makes one propeller more efficient than another?" And this is indeed a difficult teaser, since so many factors must be correlated; but there is no reason why everyone should not avail himself of the basic knowledge behind such designs, and from there go on to carry out his own designs and draw his own conclusions, with the knowledge that he had at least commenced his attack from a scientifically strategic angle.

## Surface Generation

For all practical purposes, each blade on the propeller may be regarded as a portion of the thread of a screw, of massive pitch and depth, which performs its duty by virtually screwing its way through the water.

Let us consider the development of such a screw. The first essential is to erect a vertical spindle  $XY$  (see diagram), the ends of which operate much like the pivots which support the balance wheel of a clock. Upon and at right-angles to this spindle, mount an arm  $AB$  with a collar at  $A$  so that it is free to move up and down the spindle, as well as to turn round it. To a cable passing round a pulley  $P$  and fixed at one end to a screw which attaches to the arm close to  $A$ , attach a counterweight  $W$ , so that it balances  $AB$  in any position. Now should the arm be moved uniformly down the vertical spindle from  $A_1$  to  $A_2$ , at the same time revolving uniformly around it, it will be obvious that the outer end of the arm will travel from position  $B_1$  to  $B_2$ , and thus trace out a spiral curve; it also follows that at every point along  $AB$  a spiral curve may be traced, as for example,  $C_1$  to  $C_2$ . Therefore, the whole thread surface will in effect be a spiral or screw surface. Should the board  $AB$  make one complete revolution around the spindle  $XY$  while it descends from  $A_1$  to  $A_2$ , the height between these two points would be equal to the threads measured parallel to the axis of the screw, and this is termed the pitch. To simplify the definition we can say that the pitch is the forward distance through which the screw would travel in one revolution if the nut in which it turned were solid and fixed.

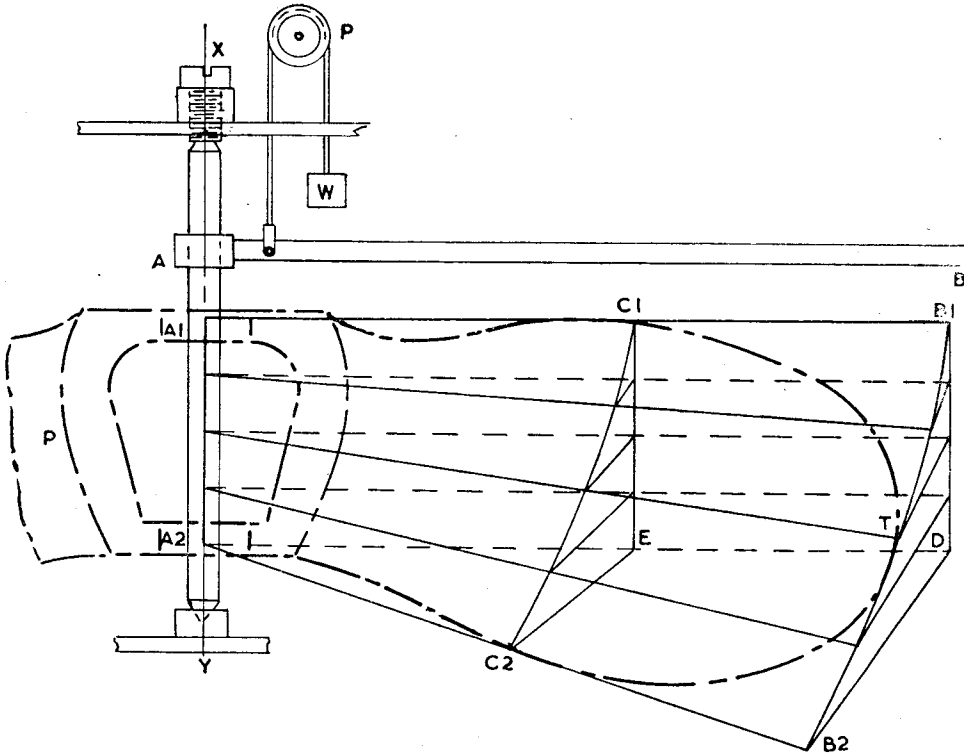
The diameter of a screw propeller is the actual

diameter of the circle described by the blade tips when revolving, or simply  $2A_1 B_1$ .

The area of this circle is known as the disc area of the screw. In the case of screws having a constant pitch throughout the blade, the angle of the blade to the vertical axis increases gradually from the tip at  $T$  towards the root; thus the angle at the tip or radius  $A_1 B_1$  in the figure is  $B_1 B_2 D$  which is less than the angles  $C_1 C_2 E$  at the radius  $A_1 C_1$ .

The circumference of the screw is expressed

$PB$ , of the flange and mark off on the curved surface the contour of the blade  $A_1, C_1, T, C_2, A_2$ ; (4) fix wooden thickness-pieces around this curved surface; (5) fill the intervening space with loam and dry it; (6) take a negative impression of the back or curved surface of the blade; (7) remove the thickness-pieces and the curved loam between them; (8) wash down with moulder's carbon wash both the flat and the curved or back surface of the blade mould and put the halves together, adjust



as  $2\pi$  times the radius of the blade or  $2\pi \times A_1 B_1$ . Should you plot a vertical line to scale for the pitch and a horizontal line at the same point to the same scale for the circumference and join their extremities, then the angle of the screw will be represented by the angle contained between the hypotenuse and the base or circumference line.

It can now be readily seen that in order to form the flat or forward surface of a screw propeller blade, it is necessary (1) to erect in the foundry the vertical spindle  $XY$  with the arm  $AB$  and set up a wooden template  $B_1 B_2 D$ , at the extremity of the radius, having the correct angle to give the desired pitch; (2) establish (with bricks) a firm, solid backing behind the curved surface  $A_1 B_1 B_2 A_2$ , covering it with loam, sweeping it smoothly down to the board  $AB$ . Dry it and wash it down with black carbon wash; (3) cut away the central part of the curved surface so as to admit the propeller boss pattern

the central core, dry thoroughly, and pour in the metal.

To find the pitch of a screw propeller, first plumb the axis or level points on the blades equidistant from the centre. Now describe a circle with the axis as a centre on the upper face of the boss. Describe a radial line on the boss from the centre, in line with the front edge of one of the blades, and lay a long straight-edge level along this radius line. Next, measure the vertical distance from its under-surface to any desired point such as  $C_1$  at a radius  $A_1 C_1$  from the centre. Move this straight-edge round  $1/12$  of the circumference of the circle on the boss, level it again and measure at the same radius as before; the vertical measurement in inches represents the pitch of the blade in feet.

The earliest forms of screw propellers were of the single-threaded kind, consisting of part of a true helix cut off by parallel planes at right-angles to the axis, and even after double-threaded

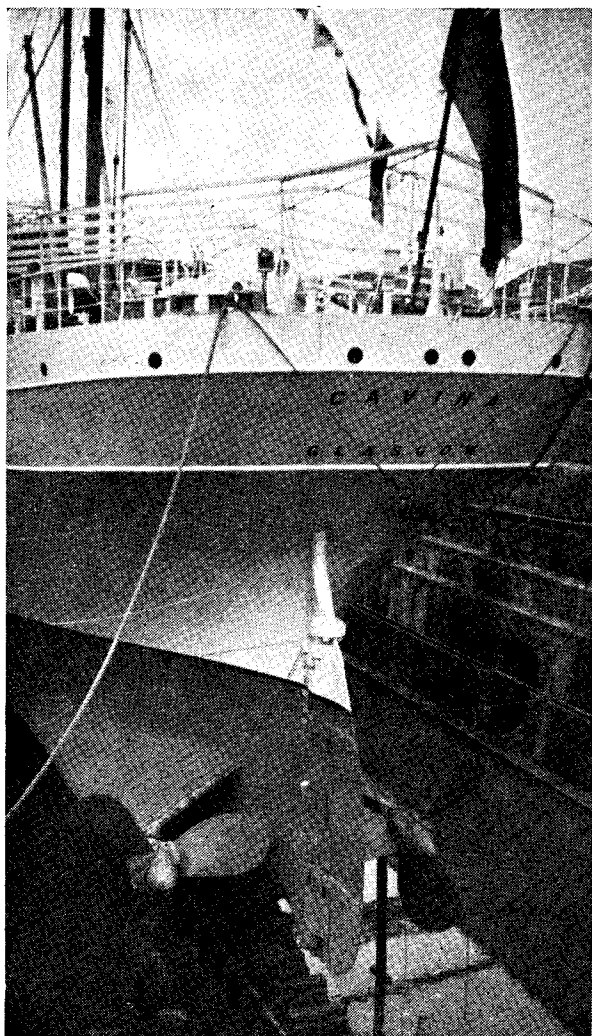
screws came into vogue, it was supposed that a full turn or more of the thread was necessary in order to insure reasonable efficiency. Correctly speaking, the single-threaded screw has only one blade, but this form of screw was not long in use, and the two-bladed or double-threaded screw was the one which was employed for a number of years, the length being about  $1/6$  of the pitch. The pitch of the blades was usually uniform, but sometimes with the leading half made less than that of the following half, so as to make the effort of the blade on the water more gradual.

### Slip

Let us try to imagine for a moment a screw working in a solid unyielding nut. In this case, the distance travelled by the ship in a given time would be equal to the number of revolutions made by the screw in that time multiplied by the known pitch; in practice, however, the water which forms the nut for the propeller is not unyielding, and as a result, the ship advances a distance equal to the pitch for each revolution. The difference between the speed of the ship, and that of the screw is termed the apparent slip. To find the true slip of any screw, the velocity of the stream of water which follows a ship, and in which the screw works, must be known; the actual velocity at which this column of water is thrown back by the screw in a direction opposite to that in which the ship is travelling, represents the screw's true slip.

### Thrust

Considering a screw-propelled vessel moving forward at a uniform speed, the re-action of the mass of water being projected backwards by the propeller is exactly equal to the resistance of the



*A good example of blade form on a twin-screw liner*

forward motion of the vessel; it would, therefore, be fruitless to attempt to design a screw propeller which would work without *any* slip, because without slip there can be no resultant propulsive reaction.

Here is a simple formula for determining thrust:—

$$\text{Reaction} = \frac{WS}{g} \text{ in lb.}$$

$W$  = weight of water acted on in lb.

$S$  = slip of screw in feet per sec.

$g$  = acceleration due to gravity (32.2 ft. per sec.).

The resultant figure will be the thrust acting on the ship along a line drawn through the centre of the propeller shaft.

Alternatively, according to Professor Rankine in his *Rules and Tables*, page 275, Rule V:—

*To calculate the thrust of a propelling instrument in lb., multiply together the transverse sectional area in square feet of the stream driven astern by the propeller; the speed of the stream*

*relatively to the ship in knots, the real slip, or part of that speed which is impressed on that stream by the propeller also in knots; and the constant 5.66 for sea water, or 5.5 for fresh.*

Thus, if  $A$  is area of stream driven back in sq. ft., with  $S$  as speed of screw in knots, and  $s$  is speed of ship, then:—

$S - s$  is Apparent Slip.

Therefore:

The thrust in lb. =  $A \times S(S - s) 5.66$ .

Finally, in designing a free-lance model or in reproducing a model of some known ship where the screw data is unknown, it is imperative that the size, that is the pitch and diameter, of the screw be worked out first, and not the size or power of the propulsion unit. Remember that the engines exist only as a means of driving a propeller of pre-determined design.

(Continued on page 834)

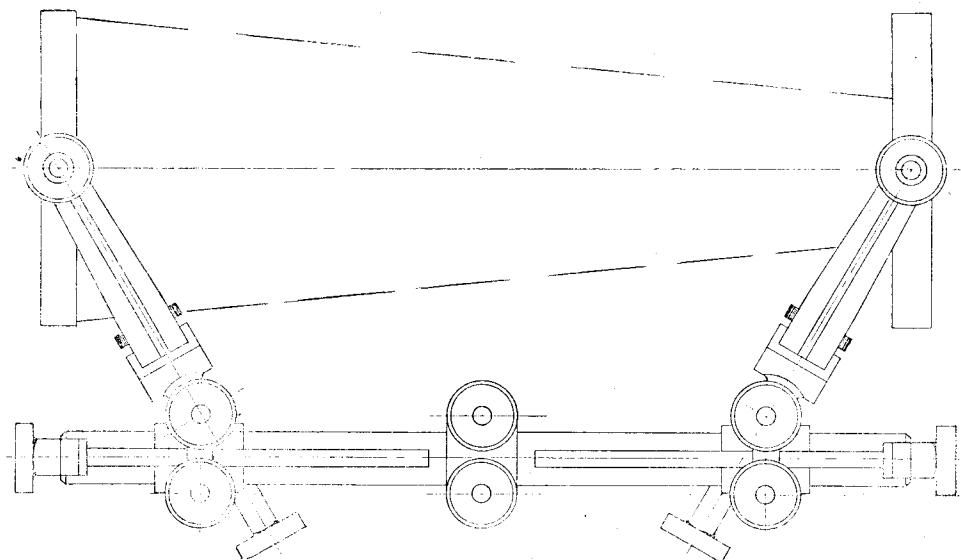
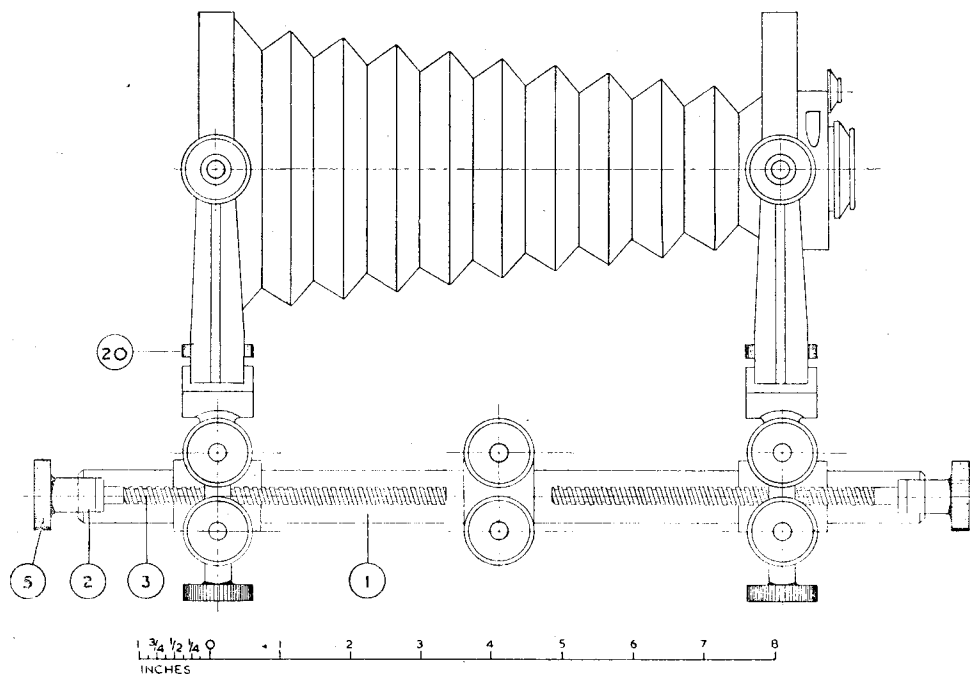
# CAMERA CONSTRUCTION

by Andrew Todd

THE letters on camera construction which have appeared in THE MODEL ENGINEER recently have been most helpful to me, and I would like to thank all the writers for their

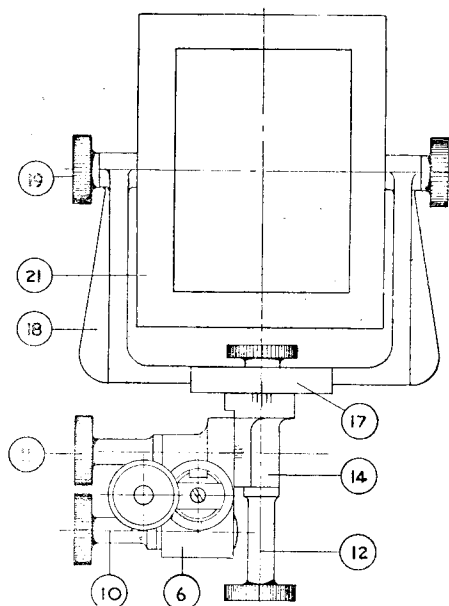
remarks, and also to thank all my friends who have written to me privately with offers of help and material.

I have been interested in photography for

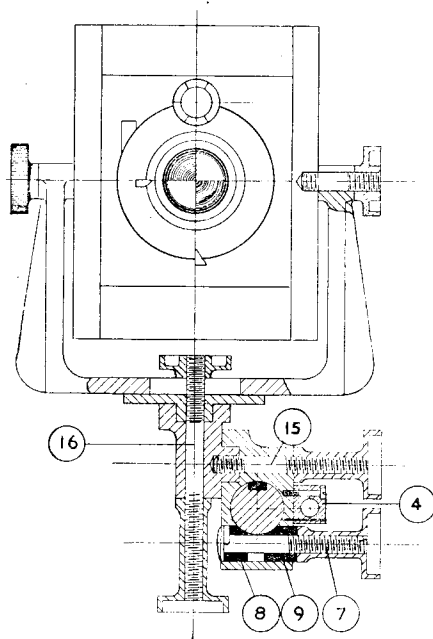


about 20 years ; I am not an artist, and I am not concerned with whether a picture is artistically correct or not ; what I am interested in is, can the details be seen clearly? To be able to say that *that* spot is a hexagonal bolt, is much more important to me than that a pipe running at an angle across a corner of a picture upsets the balance of that picture : I think it best to be able to see the bolt-head clearly on the pipe flange. If the particular detail that I want comes

It is when I want to photograph models that I find the camera unsuitable ; I have taken some good pictures, but I have lost a lot more. I have had some experience with a number of field and reflex cameras ranging from 2½ in. sq. to whole plate. At first I thought it grand to be able to see the picture on the glass screen and know that that would appear on the negative ; but did it ? The ¼-plate reflex camera used to jump and tremble when the mirror rocked and the shutter



*End elevation*



*Section through clamp*

in the middle of the picture, then I am satisfied. Clear, sharp detail is what I want ; a certain haziness of outline may be attractive in a woodland scene, but is out of place in a photograph of a tool or engine.

I know that many photographers do not agree with me. I can enjoy looking at an exhibition of portraiture, etc., but I get much more enjoyment looking at a commercial photographer's showcase when he is interested in engineering subjects. There used to be one near the old premises of the Glasgow S.M.E., and I have spent a lot of time looking at samples of his work.

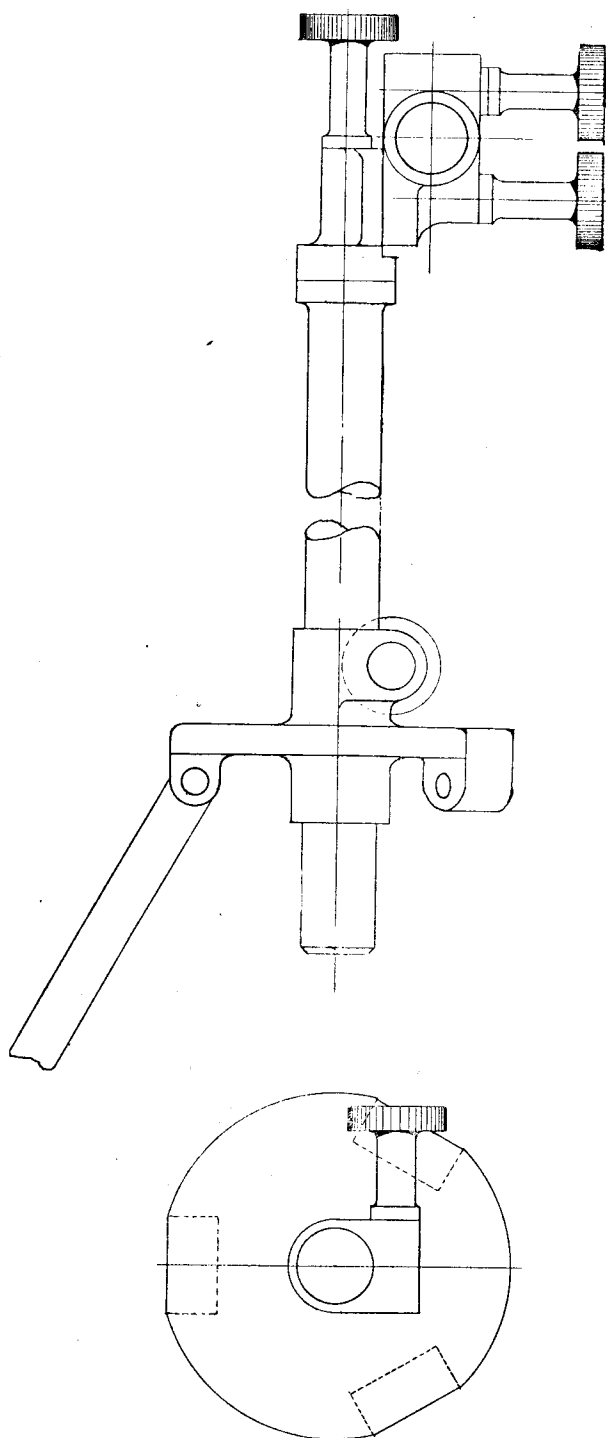
I have taken several hundred photographs with my camera. For 8 months I took about three films a week on the building of a gas-holder, and got some excellent results—there are some interesting things to photograph on a gas-holder. Some of them have pistons over 100 ft. diameter, and a stroke of up to about 300 ft. Many a time have I stood in a gale 200 ft. above ground level while trying to photograph some assembly job being carried out, and I have been perfectly satisfied with my camera for such work. It is an F.4.5 folding one, taking 620 films, it cost £5 5s. with case 18 years ago, 12s. 6d. extra being paid for the tripod.

was operated. The field camera would move on its tripod when the focussing screen was being removed to fit a dark slide. I will say that the old pneumatic shutter operated perfectly without any trace of vibration.

When the camera was extended to near its limit for a close-up, the camera used to rock on the tripod with the least little bit of wind. I did know that most photographers have had to put up with these troubles, and that cameras could be had that did not do these things. Unfortunately, they always sold at a lot more than I could afford.

For some years now I have promised to make myself a camera. During the recent correspondence, many readers offered to sell me cameras at a reasonable price, but while appreciative of these offers, I did not want to buy one. I really would prefer to make my own.

The problem of what kind of camera to make was the reason why I wrote to THE MODEL ENGINEER in the first place. I wanted to know what others thought was the ideal camera for model work. Now I know. I want a camera to take from 35 mm. film up to whole plate size, with bellows extension from 1 in. up to 24 in. and a full battery of lenses from f.2 to f.100 and



*Arrangement of tripod-head*

focal length of 1 cm. to 1 ft. It should be a reflex camera with focussing screen on back, rising, cross, and swing back and front, triple extension bellows. It should take up very little room and weigh next to nothing! Joking apart, I find there is no agreement amongst us, as to the best type to make. The field camera does appear to be the most popular with a plate size of  $2\frac{1}{2}$  in. by  $3\frac{1}{2}$  in.

### Importance of Size

I have decided to design my own camera to take this size of plate. The size of plate is important; if it is smaller than this, it is very difficult to touch up any blemishes which may appear on the negative, or to alter the background a little. I also find it is difficult to focus objects clearly, owing to their small size.

The big negatives to not suffer from these troubles, but they are expensive. The cost of an enlarger is considerably increased, and while it is not so important to enlarge a  $\frac{1}{4}$  plate, as it yields a nice size of print, it is a necessity with the smaller sizes. I decided to adopt this size of  $3\frac{1}{2}$  in. by  $2\frac{1}{2}$  in. because my other camera is that size, and I have a lens to suit it, and chiefly because I was presented with some dark slides in this size.

It had been my intention to make a simple, but rigid, metal camera with telescopic tubes in place of bellows. I don't like bellows; I have suffered a lot from leaks and pinholes, sagging bellows, bellows that stuck open and wouldn't fold up. Alas! When I got down to it on the drawing board it did not look so good.

### A Magnificent Effort

During the war I spent a week in a small Cheshire village in digs, and there was an American airman there, whom I was able to help with a little machining operation. This fellow was a wonderful craftsman. He was making a camera when he got the time to work on it. The camera consisted of a back and front connected by a series of telescopic tubes. The lens and shutter and frame for the dark slides were mounted in spherical guides which allowed them to tilt 10 deg. in any direction from the true axis. They could be locked positively in any position, and could be reset in true axial alignment with each other in an instant. The camera took plates about the size of miniature slides; it was a magnificent effort. I went back a week later to finish my job but he had left, and I never heard of him again.

I did not want to make a camera with rising, cross and swing front. I know all the advantages of these

movements; I also know what the disadvantages of them are. However, to please my friends, I have decided to incorporate them, complete with bellows!

### To Absorb Vibration

A 12 in. extension of bellows was considered reasonable for this job. I am not much concerned about the overall size of camera. I do not see any sense in reducing every part to the lightest and smallest dimension. My camera will be fairly heavy to absorb vibration, as I am fond of photographing various engines I meet up with in my employment. In some of these old engine houses, the floors are not too good and vibrate a lot, and a tripod is useless under these conditions. I often sit a barrel on end on the floor, tie my camera to a 56 lb. weight, and sit the weight on two rubber sponges, this is the best way I know of damping out vibration. Sitting a heavy camera on a light tripod is asking for trouble, and I was glad to see a design for a solid-looking tripod in THE MODEL ENGINEER a few weeks ago.

The overall size will also be fairly large. Hinged and folding base boards cut down the size of a camera, they also introduce complications. The camera *must* be rigid; there must be no movement whatever between slides once these have tightened, or movement to upset the focus after composing the picture. All moving parts must be fitted with large knurled knobs to clamp them together;

light alloy will be used extensively in the design.

I regret that I am unable to help Mr. McNarry, as my design will require a decently equipped workshop to make it. A lathe is a necessity.

One reason why I want a camera is because I have been unable to take a good photograph of my brother's miniature ship models.

When I started to design this job I got hold of some text-books on photography, and I had just come to the same conclusions as given in Mr. Clue's letter. I will have to be content with a smaller picture, and make an enlarger to go with the camera. In submitting the drawings for the criticism of readers, I would like to make a few observations.

I made the general arrangement first, and some differences will be noticed in the details. When doing a job of this kind I seldom make a completely detailed set of drawings, it being my habit to make a general arrangement showing roughly where the various parts have to go and make the parts to fit each other. I have not detailed the method of fixing the bellows to the frame, as I do not know how this is done, and will worry over it when I get the bellows. Nor have I detailed out the rails for the dark slides or for the rising front, as these depend on the type of parts available.

The sketches on the previous page show the tripod-head I propose using. I have still to decide what type of legs to use.

(To be continued)

## For the Bookshelf

**The Locomotives of the Great Western Railway, Part 1.** (Published by the Railway Correspondence and Travel Society.) 62 pages, size 6 in. by 8 in. Illustrated. Price 10s., pos free.

The locomotive history of the Great Western Railway is unique, in that it covers a period of more than 100 years of continuous development. The enormity of the task of writing a comprehensive and complete record seems, hitherto, to have daunted the individual historian, however, well up he may have been in the subject; but this book is the first of a series to be devoted entirely to the one subject, and if the degree of completeness it shows is indicative of what is yet to come, a long-standing need will be filled in a thoroughly worthy manner. The work of compiling the information is being undertaken by a team of G.W.R. specialists supported by competent, if amateur, editorial assistance, which makes the result of their combined efforts all the more noteworthy. It may be that modern conditions tend to stimulate something near to perfection in the art of compressing a great mass of essential material into a small space, and this book is an object-lesson in how it can be done. Readable and entertaining, yet concise and informative, each of the eight chapters is a model of its kind.

The subjects dealt with in this preliminary survey include: the locomotives built or acquired by the G.W.R. during 110 years; the works lists; the styles of painting; the engine diagrams; boiler changes, classification of engines; automatic train control, and the traditional four-weekly periods of stock changes.

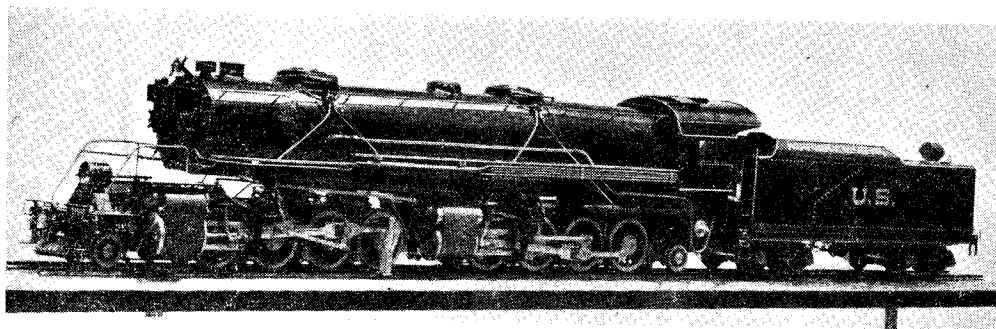
The frontispiece is a well-executed full-page plate in colours depicting an Armstrong "Standard Goods" engine as rebuilt at Wolverhampton in 1885 and painted in the livery then usual for Wolverhampton engines. The illustrations comprise five diagrams and no fewer than 82 halftone reproductions; most of these are printed on art-paper inserts and, in themselves, make up a fairly complete pictorial record of G.W.R. locomotive development. There are also two well-arranged and comprehensive tables included on folded inserts in the text.

All concerned, if only because they are voluntary and mostly amateur authors and editors, are to be warmly congratulated upon the masterly manner in which they have tackled a most formidable task in face of crippling difficulties, and we express the hope that conditions will not delay too long the successful completion of what promises to be the most complete locomotive history ever produced.

The book is obtainable from Mr. D. H. Wakely, 18, Holland Avenue, Cheam, Surrey.

# Australia WILL be There

by V. H. Messer, Hon. Sec., S. Aust. S.M.E.

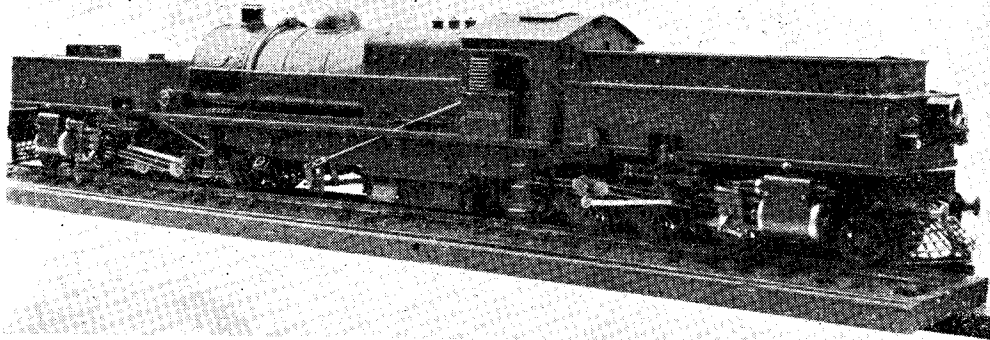


*How's this for a first attempt? Mr. A. Bailey's 2 1/2-in. gauge Norfolk and Western articulated locomotive*

MR. ED. ADAMS'S article "Tales of a Tyro," in the March 15th issue, instantly gave me the urge to let him and readers know that the U.P. Mallet has a sister in Australia built years before friend Adams produced his specimen. The first photograph reproduced herewith is of a 2 1/2-in. gauge version of a Norfolk & Western articulated locomotive built by Alec Bailey, a member of the South Australian Society of Model Engineers in 1932, incidentally it was brother Bailey's first attempt and believe me, it's "some" job. It also was built from drawings in the *Locomotive Cyclopaedia*. The photograph shows a cut-out picture, to scale, of the owner; this gives some idea of the size of the prototype.

Here are a few particulars: Gauge 2 1/2 in., length 52 in., height 8 in. bar-frames, and yes, Mr. Adams, complete compensated springing! A true compound, H.P. cylinders 1 1/4 in. x 1 3/8 in., L.P. 1 7/8 in. x 1 3/8 in., inside admission piston-valves, both pistons and valves have rings; connecting- and coupling-rods, nickel-steel, valve-gear, stainless-steel, automatic stoker and complete working air brakes; it is 10 in. longer than my Beyer Peacock 2-8-0 + 0-8-2 Garratt also built in 1932 (see second photograph).

Friend Adams' sketch showing use of watch-maker's eyeglass caused me to smile; I find that I have to use one quite a lot on small jobs encountered in building my *Shay*; age will tell.



*Mr. V. H. Messer's model Beyer Peacock Garratt locomotive*

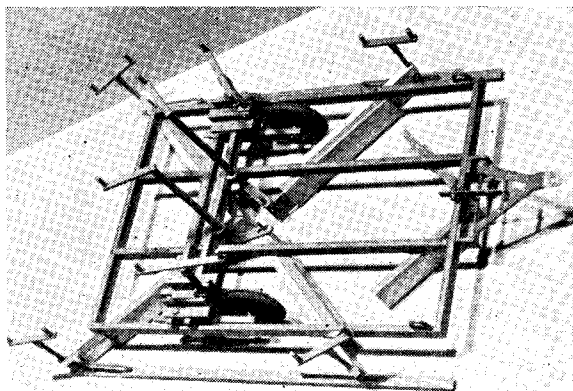
# An Unusual Model

by J. Handel

FROM time to time the pages of THE MODEL ENGINEER contain pleas for more unusual models, and recently a local engineering firm presented me with the opportunity of "getting out of the rut." Perhaps I should explain that although our town has only about five thousand inhabitants, we fairly bristle with industrial concerns; lace net, plain-bearings, pencils, agricultural machinery and overhead trolley gear are all made here, to say nothing of the products of the firm for whom this model was made, the Phoenix Engineering Company, whose concern is the manufacture of road-making and maintenance plant.

Needless to say all these firms are a veritable model engineer's paradise—the lace mill has a Watt beam engine of about 1800 but it has been modified over-much—and I am pretty well acquainted with them and they with those "peculiar" people who make models!

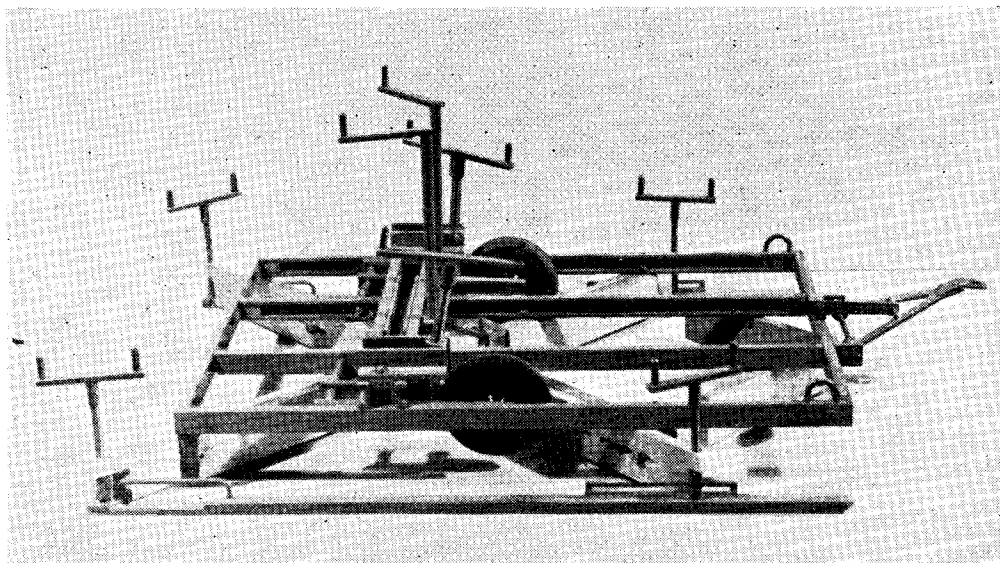
In view of all this, about six weeks before the Public Works Exhibition at Olympia, I was asked if I would construct a demonstration model of the "Phoenix-Edwards Spreader," a machine which is used for the rapid laying of cold asphalts



and tar-macadam in a continuous operation, as the vehicle dumping the tar-mac tows the spreader at the same time; a road roller follows up, and the job is done.

The model is to  $\frac{1}{4}$ th scale and consists of a frame of  $\frac{1}{2}$  in.  $\times$   $\frac{1}{4}$  in. channel steel, milled from solid bar. Attached to the underside of the frame are "screeds," the front and rear ones being arranged rather after the manner of the old-time snow plough, while the centre one is in the reverse direction. The first one is fixed, while the centre and rear ones are adjustable for the width of material it is desired to lay. The shape and disposition of these screeds will be apparent from the photograph. The right and left sections of the front and rear screeds meet on the centre-line of the machine, while the centre one has a gap which may be closed by feed doors operated by the handles on top of the central columns. The movable sections of the

(Continued on page 833)



**B**EFORE fitting the tops to the tanks, or putting anything inside them, it would be advisable to erect them on the running-boards. The tops can then be made to an exact fit against the boiler. First of all, drill four No. 40 holes in the bottom of each tank in the position shown in the illustration; these need be approximate only, as the holes in the running-boards are drilled to suit. Now place the left-hand tank in position, as shown. The distance from the outside of the leading buffer beam, to the front end of the tank should be  $5\frac{1}{4}$  in. on either the smaller- or larger-boilered engine. On the former, the tanks should be  $\frac{1}{2}$  in. from the edge of the running-board; on the latter, a shade less, say  $\frac{1}{8}$  in., so that the inner side sheet of the tank, just misses the boiler. If it touches, some of the heat of the boiler will be dissipated into the tanks, and the boiler will not steam so well. When the tank is correctly located, clamp it temporarily in position; about the easiest way to do this, is to lay a stout piece of metal, say a bit of  $\frac{1}{2}$ -in.  $\times$   $\frac{1}{2}$ -in. bar, across the top at about mid-length. Then put the carpenter's G-cramp over it, the curved part going under the running-board, and the screw pressing on the cross-piece. Put a No. 40 drill with extended shank—I've already explained how to fit short ends into pieces of  $\frac{3}{8}$ -in. rod, to make extension drills—through the holes in the bottom of the tank, and carry on right through the running-board. Clean off any burrs underneath, and put brass screws in either  $\frac{3}{32}$ -in. or 7 B.A. Nut them over underneath, then solder the over heads, to prevent water leaking through. Beginners who are inexperienced with soldering-irons, and who might manage to let the solder get down between the running-board and tankbottom, thus making a permanent fixture of the whole works, had better remove the tank, put the screws through the holes, and solder them whilst the tank is off the running-board. Any surplus solder that creeps through, can be scraped off, or else removed with any old rough file that has seen better days.

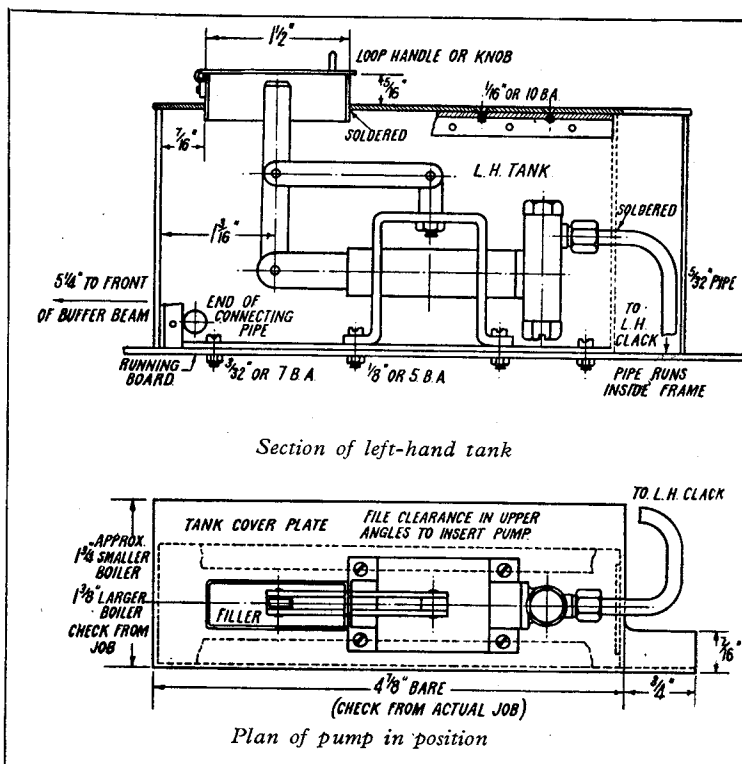
The primary object of drilling clearing holes in the running-board and using nutted screws, is to render the whole tank easily removable; all that is needed, is to take off the nuts and lift the tank clear. The soldered-over heads not only prevent leakage, but retain the screws in position, and prevent them turning when the nuts are slackened off.

## "L.B.S.C.'s" Begin

### How to Erect "Tie

#### How to Erect the Hand-pump

First make a solid base for it by cutting two pieces of 16-gauge brass or copper,  $\frac{3}{8}$  in. wide, and just long enough to fit between the angles at the bottom of the tank. They can be fixed by a couple of  $\frac{1}{16}$ -in. rivets in each, or soldered, or both. The position is shown in the detail illustration. The pump can then be put in.



As the stand is wider than the distance between the top angles, a clearance will have to be filed at each side, to admit it. Set the pump handle vertical, and then adjust the pump in the tank, so that the centre of the handle is approximately  $1\frac{3}{8}$  in. from the front end of the tank. No need to bother about "mike measurements," but the pump should be central between the tank sides. Make countersinks on the seating or base, by aid of an extension drill (No. 30), put through the holes in the lugs at the bottom of the pump stand. Remove pump, drill right through the

# Beginners' Corner

## et "Tich's" Tanks

base pieces, tank bottom, and running-board with No. 30 drill; scrape off any burrs, and replace pump, fixing it temporarily with a couple of 5-B.A. screws and nuts.

Be careful about the next bit. Measure from sides and bottom of tank, to the centre of the union nipple on the pump valve box. Transfer these measurements to the outside of the back

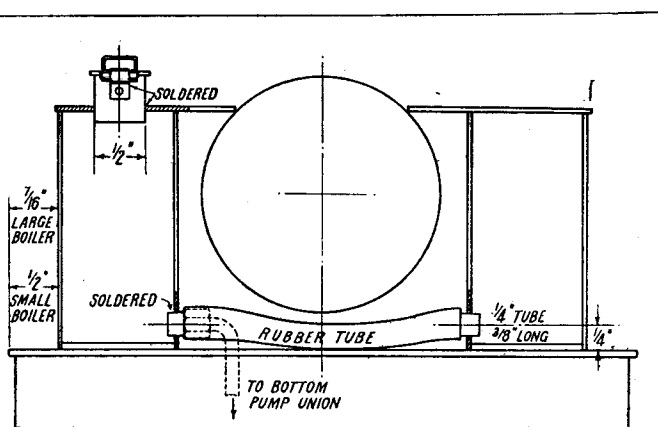
detailing out again, as it was dealt with along with boiler fittings; you should be well able to draw on your experience by now! When silver-soldering the cone to the pipe, heat the whole pipe to dull red, quench the lot in the acid pickle, and run some water through it before cleaning up. This will make it ductile enough to be easily bent by finger pressure alone. Remove pump, poke the pipe through the hole in the end of the tank, from the inside (it may be bent a little for this purpose) then put the pump back temporarily again, and couple up the union. Remove the tank, solder around the pipe where it comes through, then bend it right around, as shown in the illustrations, so that it points forward. Replace tank temporarily, and adjust the pipe bends so that the pipe runs along inside the frame, turns upwards under the left-hand clackbox, and meets it. Take off the tank again,

and fit a union nut and cone ( $\frac{1}{4}$  in.  $\times$  40 as before) to the upturned end of the pipe. Whilst the tank is off, drill a  $\frac{1}{4}$ -in. hole in the inside sheet, about  $\frac{1}{4}$  in. from the bottom, and just clear of the vertical corner-angle. In this, solder a piece of  $\frac{1}{4}$ -in. pipe about  $\frac{3}{8}$  in. long, to form part of the connection between the two tanks. The tank can then be replaced, and permanently fixed, by nutting the screws under the running-board, and fixing the pump by four  $\frac{1}{4}$ -in. or 5-B.A. brass screws with a smear of plumbers' jointing under the heads. Couple up the union on the front end of the pipe, to the left-hand clackbox.

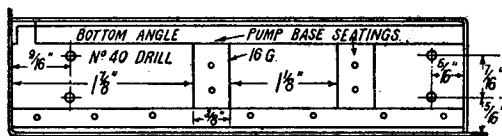
### Right-hand Tank

To erect the right-hand tank, take off the reversing-rod temporarily, and proceed in a manner similar to that described for the left-hand merchant; then, whilst it is in place, check off each on end the location of the tube through which the reversing-rod passes. The centre of this should be  $\frac{1}{4}$  in. above the frame at the back end, and  $\frac{1}{16}$  in. at the front, as shown in the illustration;

on the smaller-boilered engine it should be approximately  $\frac{7}{32}$  in. from the outside sheet, and on the larger,  $\frac{9}{32}$  in., as the tanks are a wee bit farther apart. Then take off the tank and fit the tube. For this you need a bit of thin  $\frac{5}{16}$ -in. copper tube  $4\frac{1}{2}$  in. long. Soften it by heating to red and plunging into water; clean the ends, then put it between the vice jaws and squeeze it oval. To get an even squeeze without making marks on the pipe—not that it would matter, as Inspector Meticulous can't see through the tank sheets!—put the tube between two bits



How tanks are connected



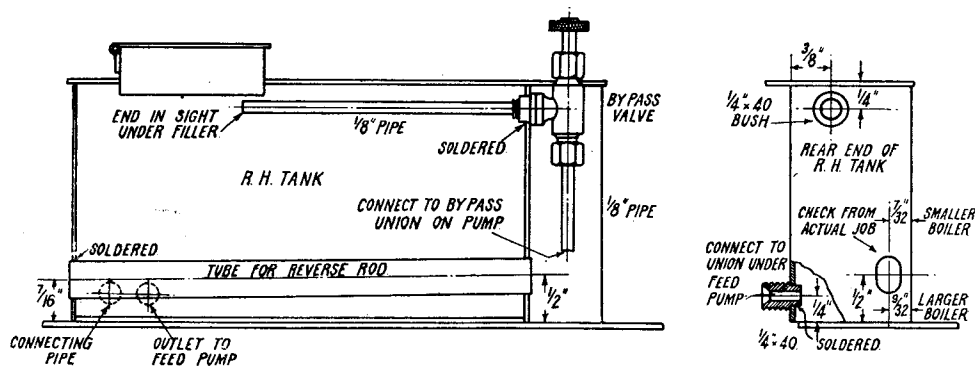
Tank bottom with pump supports

end of the tank; mark the spot, and drill a No. 41 hole. Poke a bit of  $\frac{3}{32}$ -in. wire, or a drill shank, through the hole; this should go straight into the hole in the union nipple. If it doesn't, a little judicious administration of a small rat-tail file will be necessary to line up the hole with the union; when this is O.K., open out the hole with a  $\frac{5}{32}$ -in. or No. 22 drill.

The next item needed, is a piece of  $\frac{5}{32}$ -in. copper pipe approximately  $10\frac{1}{2}$  in. long. One end of this is furnished with a  $\frac{1}{4}$  in.  $\times$  40 union nut and cone, a job which should not need

of wood 5 in. long or a little over, and put the whole lot in the vice-jaws. If you put the end of the tube against the tank, and run a scriber around it, you'll get the exact shape of the necessary hole. Drill a round one in the middle of the marked spot, with a  $\frac{3}{16}$ -in. drill, and file to outline. Then push the tube through, solder both ends from the outside, and add a fillet of solder inside. It doesn't matter if the tube

piercing the tapped part; and in this, put a fitting similar to the one at the top of the water-gauge, but shorter. This one should only be  $\frac{7}{16}$  in. from the shoulder to the centre of the valve, and screwed  $\frac{1}{4}$  in.  $\times$  40. Drill it  $\frac{3}{32}$  in., open out the end for  $\frac{3}{16}$  in. depth, to take a 3 in. length of  $\frac{1}{8}$ -in. thin-walled pipe. Silver-solder both joints at the same heating. After pickling and cleaning up, put the tap down the spindle hole



Right-hand tank details

projects a little to the rear, but file the front almost flush with the end of the tank.

Make a bush from  $\frac{3}{8}$ -in. rod—brass will do for this—turning the “step” to  $11/32$  in. diameter, drilling  $7/32$  in. and tapping  $\frac{1}{4}$  in.  $\times$  40; same process as used for the backhead bush. At the position shown, viz.,  $\frac{1}{4}$  in. from top, and  $\frac{3}{8}$  in. from inside sheet, drill a hole with  $11/32$ -in. drill, and solder the bush into it. This bush carries the by-pass valve, by which the water delivered by the eccentric-driven pump is returned to the tanks when not required for the boiler. Our Stroudley tank engines on the L.B. & S.C. Rly. had a similar arrangement, except that the valves were inside the tank, and were operated by small handles, with quadrant and locking-screw, on the ends of the tanks inside the cab. The pumps, like the one on *Tich*, were always pumping water, and the amount going into the boiler could be regulated to a nicety.

### By-pass Valve

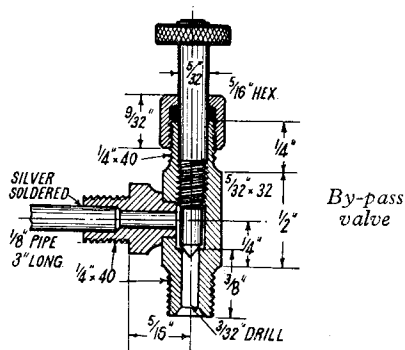
The valve itself is made in the same way as the blower-valve, as you can see by the section shown here. Part off a piece of  $\frac{5}{16}$ -in. rod, round or hexagon, 1 in. long. Chuck in three-jaw, face, centre deeply with E-size centre drill, and put a  $3/32$ -in. or No. 43 hole clean through. Turn down  $\frac{1}{4}$  in. length to  $\frac{1}{4}$  in. diameter, and screw  $\frac{1}{4}$  in.  $\times$  40. Reverse in chuck, and ditto repeat turning and screwing operations. Open out to a bare  $\frac{3}{8}$  in. depth with No. 30 drill; if you have a D-bit that size, it would be a slight advantage to bottom the hole with it, although it doesn't really matter on a small water valve. Further open out to  $\frac{3}{16}$  in. depth with No. 21 drill, and tap the No. 30 part either  $5/32$  in.  $\times$  32 or 40. The coarser thread gives a quicker action to the valve.

In the middle of the body, drill a  $\frac{3}{16}$ -in. hole,

again, to clean off any burring; after which, beginners can put their acquired knowledge and skill to test, by fitting the handwheel, spindle, and gland nut, exactly as I described for the blower-valve. You should be getting quite experienced hands by now! Screw the completed fitting into the bush, on the end of the tank, as shown in the illustration; and if it doesn't come up straight when tight, either take a shade off the face of the bush, or else put a thin washer between the bush and shoulder. Washers can be made to any thickness, by parting slices off a drilled rod of suitable diameter, held in the three-jaw.

Now we need two final small items. First, solder a  $\frac{3}{8}$ -in. length of copper pipe into a hole drilled in the lower front corner of the inside tank sheet (see illustration) for the connecting-pipe between the two tanks. Right alongside this, fit a  $\frac{1}{4}$  in.  $\times$  40 union nipple, made just the same as the ones on the blower-valve and whistle turret. This can also be soldered in, as there is neither heat nor pressure to withstand. Before permanently fixing the tank, there is now a little job of plumbing to do. Put the tank temporarily in position; and with bits of lead wire, or soft copper wire, get the exact lengths of your pipes. Measure from the bottom union of the by-pass valve, to the back-pointing union on top of the valve-box of the eccentric-driven pump; and from the union nipple at the bottom of the tank, to the union nipple under the pump valve-box. Cut two pieces of  $\frac{1}{8}$ -in. thin-walled copper tube—I use 24-gauge tube for these jobs—and fit union cones and nuts to both ends of each; another little job you can do “all by yourself” now. Soften the pipes whilst doing the silver-soldering of the cones. Attach one end of each to the by-pass valve and the outlet union, and bend them carefully so that the pipes will couple up to their

respective unions on the pump; then put the tank in place, adjust the pipes to meet the union screws, and couple up the union nuts. Whilst on the plumbing racket, couple up the forward-pointing union on the pump, to the union under the right-hand clackbox, with a piece of  $5/32$ -in.



copper tube, with union nuts and cones on each end.

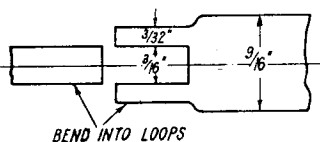
Put the reversing-rod, or reach-rod, through the "tunnel" in the tank, and couple it up to the reverse lever, and the arm on the weighbar shaft; see if the lever works all right, and if all is O.K., as it should be, put the nuts on the fixing screws under the running-board. Finally, connect the two tanks with a piece of rubber tube slipped over the stub ends of copper pipe at the lower front corners of the tanks. The above instructions apply to engines with Walschaerts gear; same will do for loose-eccentric engines, but there will, of course, be no need to fit the tube through the right-hand tank, as there will be no reversing-rod.

### Tank Tops

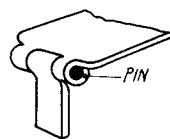
The rest is just the proverbial "piece of cake." The tank tops are made from 18- or 20-gauge sheet brass, and just overlap the tank sheets at sides and front, sufficiently to form a beading; they should be wide enough to meet the boiler. At the cab end, a piece is cut away, as shown in the plan view of the hand-pump in place. At  $\frac{1}{2}$  in. from the front end of each, cut a rectangular

hole with rounded corners,  $1\frac{1}{2}$  in. long and  $\frac{1}{2}$  in. wide; or a little wider, if you prefer a big hole to pour the water in. Bend a strip of metal  $\frac{1}{2}$  in. wide to the shape of the hole—get the length of this by making a template with a bit of stiff paper; one of young Curly's "Wellton pattern" tricks!—and solder it in, so that  $\frac{3}{8}$  in. of it projects above the tank top. The lids are made from the same kind of metal. When cutting them out, leave two tags about  $\frac{3}{8}$  in. long,  $3/32$  in. wide, and  $\frac{3}{16}$  in. apart, and bend them into loops with a pair of round-nose pliers. Cut a strip of metal to fit nicely between the loops, and bend one end of that into a loop as well. Line it up with the other loops, and put a pin through the lot; you then have a nobby hinge, as shown in the detail sketch. Pin or solder this to the end of the filler, as shown in the tank connection view. A wire loop handle, or a small turned knob, as desired, can be added, for lifting purposes.

Finally, round off the sharp edges of the tank tops, and attach them to the angles at the top of the side sheets by  $\frac{1}{16}$ -in. or 10-B.A. brass countersunk screws; or if you are a lover of rivet heads, round-head screws may be used. Drill the No. 51 holes for the screws at approximately  $7/32$  in. from the outer edges, which will allow for the overlap, and the screws will go through the horizontal part of the angles without fouling. About  $\frac{3}{4}$  in. centres will do nicely for countersunk screws, but roundheads can be set as closely as



Filler lid hinges



you like. Temporarily clamp the top in position, put the No. 51 drill through the holes in the plate, make countersinks on the angles, follow with No. 55 drill, tap  $\frac{1}{16}$  in. or 10-B.A., put the screws in, and Bob's your uncle. The hand-pump, if and when needed, is operated with the extension handle through the left-hand filler, whilst the amount of water being by-passed, can be seen through the right-hand filler. The connecting pipe allows the water in the two tanks to keep at the same level. Next item, cab or weatherboard, and bunker.

## An Unusual Model

(Continued from page 829)

centre and rear screeds are threaded in the lugs at their outer ends to take jack-screws for height adjustment. These screws rotate in blocks, of  $\frac{1}{4}$ -in. square mild-steel, at their lower ends and the blocks are connected to the runners, upon which the machine moves when in action. For movement to and from the job, two retractable "undercarriages" are provided, together with a draw-bar, which is adjustable to suit the height of the towing vehicle. When in use, the towing

vehicle is attached to the spreader by a chain passing through the U-shaped eyes at the forward ends of the outside members of the frame. All these are reproduced in the model, but, time being short, I fought shy of square threads for the lifting screws which are  $5/32$  in. diameter.

In action, the model lays a perfectly even layer of material, bird-sand being used as a near scale representation of tar-mac, and it does its job just like the real thing.

# Twist Drills and Reamers

I SUPPOSE most of us have had envious thoughts about those legendary engineering shops where all the reamers cut size or plus and minus on nominal as required, and where every conceivable size of counterbore and countersink is available.

But those of us in the industry realise that only production shops are so equipped normally. In the majority of engineering shops the reamers are down on nominal size and the fitters have to "fiddle" to get a size hole. The usual method is to raise a burr on the cutting edge of the reamer by rubbing a burnisher or something hard (a round tool bit, or the end of a file ground smooth) along the cutting edges (Photograph No. 1). The treatment is only effective if used after the hole has been reamed normally first, and will remove up to 0.002 in. from two or three holes; the treatment can, however, be repeated.

As far as counterbores are concerned, most shops have a few, but by some mischance the size you require is usually lost, stolen, strayed or broken! So invariably the fitter will use two twist drills of the appropriate size, one ground flat ended, and the other at the normal angle with slight negative clearance to stop the drill

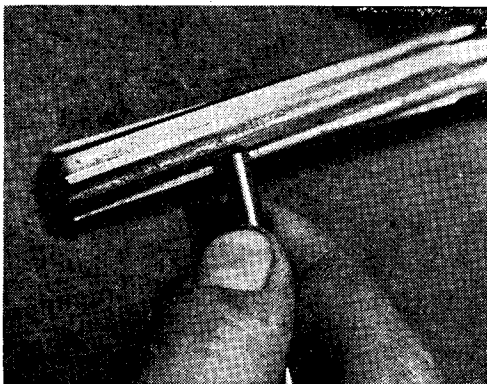


Photo No. 1. Using a tool bit to burnish cutting edge of reamer

from snatching at the hole to be opened up. The drill should be ground normally first, and then as a final touch, instead of starting to grind the drill at the clearance angle, it should be presented to the wheel at an angle of two or three degrees the "wrong" way. This will give a slight negative clearance immediately behind the cutting edge, and normal clearance thereafter (Photograph No. 2). To counterbore, the hole is first opened up with the drill ground to negative clearance, and

the bottom squared out with the flat-ended drill (remember, very little clearance on the flat-ended drill).

For countersinking, a twist drill (about 0.007 in. to 0.015 in. larger than the diameter of the screw-head) of the required size should be ground to 90 deg. included angle, and then given negative clearance. This method obviates chatter and is superior to drilling through pads of rag.

If you wish to drill brass, gunmetal or bronze, and haven't a straight-fluted drill (who has?), the twist drill should be ground as in Photograph No. 3, so that the face of the cutting edge is parallel to the axis of the drill. The ordinary twist drill will snatch on breaking through and either break or bend the drill.—A.E.U.

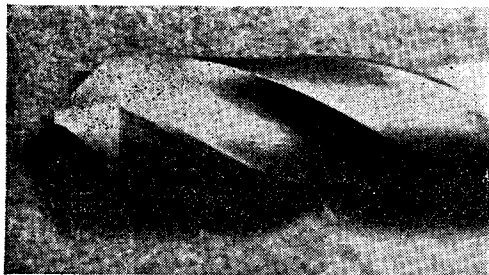


Photo No. 2. Note slight negative rake at cutting edge



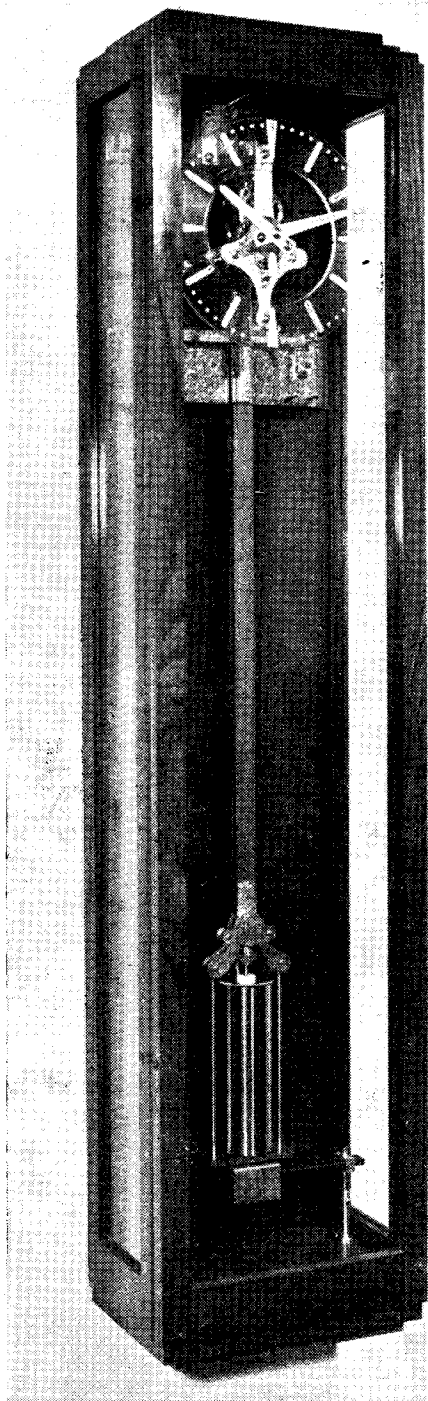
Photo No. 3. Drill ground to cut brass, bronze, etc.

## Notes on Screw Propellers

(Continued from page 823)

Having a given scale speed in mind, ascertain as near as possible the r.p.m. necessary to drive the hull at that speed, then decide on the type

and power of engine necessary. It is technically incorrect first to choose the engine and then to design the propeller.



*The completed "first attempt"*

## A Hipp Clock with Prolonged Impulse

by A. S. Prescott (South Africa)

THE making of this clock was inspired when the writer visited the 1946 "M.E." Exhibition, and was fascinated by a similar clock exhibited there by a member of the Malden S.M.E.E. A serious start was not, however, made until the publication by Percival Marshall & Co. of *Electric Clocks and How to Make Them*.

First of all, a permanent magnet had to be obtained. Many sources were tried without result. Eventually a letter to Messrs. W. B. Nicholson, Glasgow, brought not only a favourable reply, but a magnet of the size required. Meanwhile, the suspension bracket and pendulum parts were made. A piece of very well-seasoned mahogany was used for the pendulum-rod. The solenoid was wound with twenty-eight layers of two hundred turns of No. 34 s.w.g. silk covered wire. The whole bobbin was shrouded with shim brass for the sake of appearance. All electrical connections are built into the pendulum and the circuit completed by assembly of the parts. The same system is used on the switch assembly. All unsightly wires are, therefore, practically eliminated.

Contacts are of pure silver, and insulation bushes and blocks are real ivory.

The writer having no facilities for, nor skill at woodwork, sought the services of a retired craftsman from the "Emerald Isle." From a rough sketch and teakwood from the ill-fated S.S. *City of Lincoln*, at the time being broken up in Cape Town, a fine case was produced. A small compartment is provided at the bottom of the case to accommodate a flashlamp battery and dessicators. A tongue fitting into an "Apeizon" filled groove in the door renders the door fitting almost airtight.

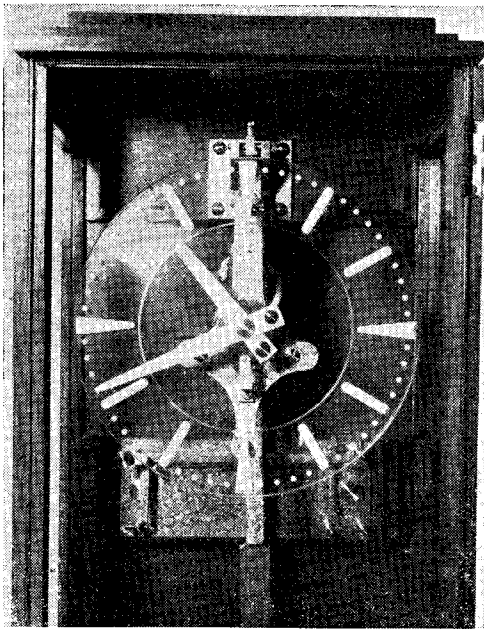
The pendulum and escapement were put on trial in March, 1950. Running free, a period of ninety seconds between impulses was recorded. After exactly one year, still running free, the period between impulses dropped to fifty-four seconds.

It was at this point that the recording movement was fitted. The period between impulses then dropped to twenty-two seconds.

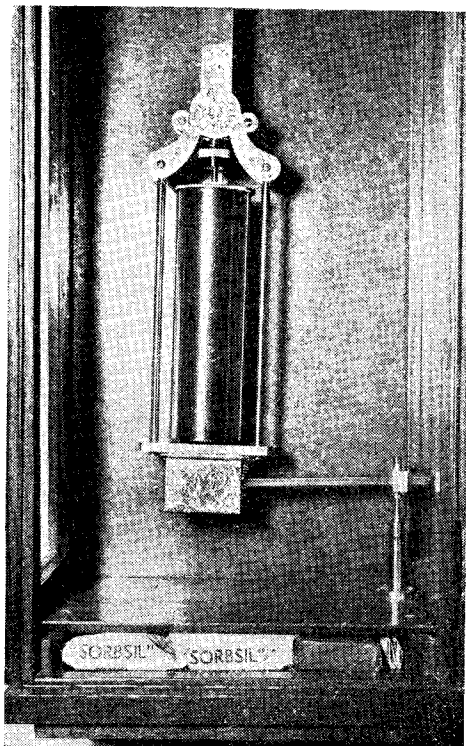
A few words about the dial movement may be of interest. This was quite a trial, as the wheels had to be purchased by post. Various Clerkenwell dealers were tried, but results were always disappointing until a new "M.E." advertiser, Messrs. A. A. Osborne were tried.

To my sketches and details they made a fine job of the wheels, and the charges were very moderate indeed. However, many weeks had elapsed in the meantime which had given the opportunity to make the dial, movement supports, plates, etc. It was here, that several departures were made from the book design.

The dial ring is of clear Perspex 10 in. diameter, with a thickness of  $9/32$  in. White Perspex



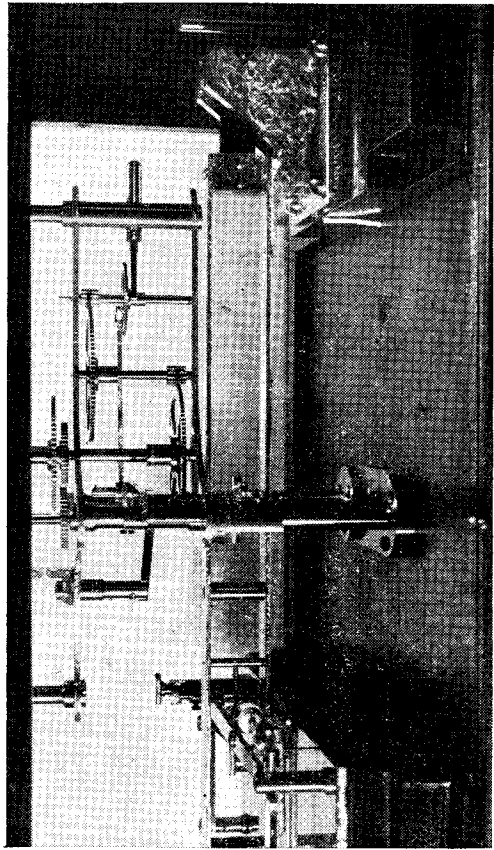
*Close-up, showing dial, switch, etc.*



*View, with door open, showing battery and dessicator compartment, solenoid, permanent magnet, etc.*

blocks of two different shapes, each secured by two 10-B.A. screws, form the hour markings. Forty-eight small mushrooms form the minute markings.

Hands are also of white Perspex, and are balanced by brass counter-weights. Special equipment for dividing the dial was made. This consisted of a division plate, detent, and a ball-bearing, drilling spindle to fit the vertical slide of the lathe. Drive to the spindle was by flexible shaft from the nearby drill press. The



*Side view, showing wheelwork, suspension bracket, switch, etc.*

whole process of drilling the eighty-four holes in the dial took little more than six minutes. The whole dial movement is supported by two pillars attached to the backplate of the movement.

At the time of writing, results over a long period can only be anticipated. Regulation to "within the pips" for a week has already been achieved.

The finish throughout follows a plan, i.e., flat surfaces are mottled, turned parts are grained in the lathe, and the whole is lacquered with clear cellulose lacquer, except flat springs, which are blue lacquered.

The photographs were taken by John Adriaan, Capetown.

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# IN THE WORKSHOP

by "Duplex"

## No. 92—\*A Die-Holder with Detachable Guides

THE two clamp-screws are fitted to the upper face of the die holder to ensure that the die beds evenly on the turned shoulder at the bottom of the housing and, at the same time, the die is kept from rising in its housing, should the fixing screws at the periphery not be truly in line with the corresponding slots in the die. As shown in Fig. 18, the position of the screws is first marked-

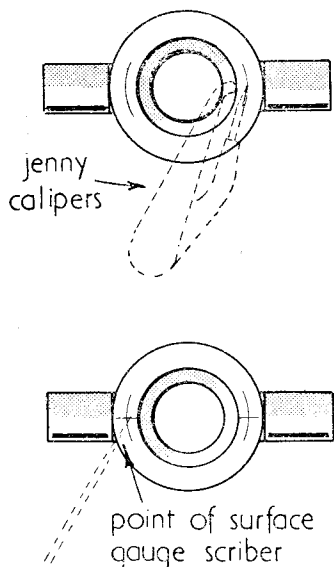


Fig. 18. Marking-out the positions of the clamp-screws

out with the jenny calipers in accordance with the working drawing. Next, the vertical slide is mounted on the lathe cross-slide and the die holder is secured in position with a single bolt passing through the collet housing, as represented in Fig. 19. The two lugs are aligned to lie parallel with the surface of the lathe bed by applying the surface gauge, and the test indicator is mounted in the chuck to set the lugs squarely across the lathe. The surface gauge is now used to scribe the horizontal centre-line across the face of the die holder at exactly lathe centre height. A centre drill, gripped in the lathe chuck, is next brought to register with the point of intersection of the cross centre-lines by turning the feed screws of the vertical and cross-slides. A centre is then deeply drilled, and this is followed by the tapping size drill and two sizes of end-mills to

form the recesses for the body and head of the clamp-screw. The screw should fit closely in these recesses so that it will not cant when tightened down on the die.

As it is important that these screws should enter squarely, the tap may be gripped in the chuck and then started in the hole.

While the clamping-screws serve to hold the

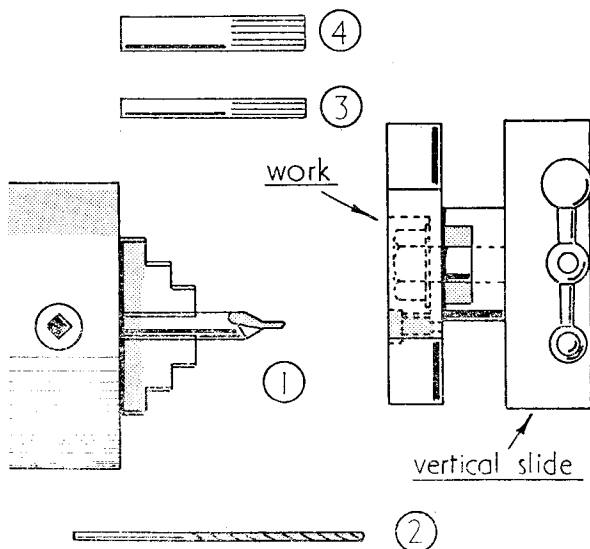
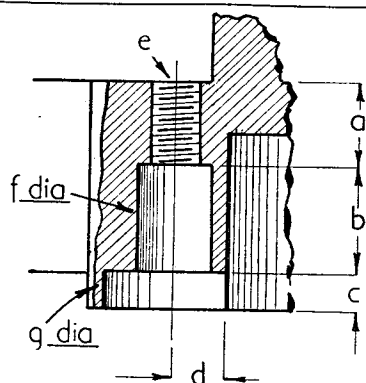


Fig. 19. Machining the clamp-screw holes

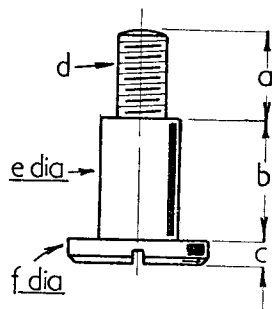
die squarely in its housing, the fixing-screws stop the die from rotating in the holder under the pressure of the cut. In addition, the split, adjustable type of die is kept from expanding by these fixing-screws, and cutting oversize is thus prevented.

The non-adjustable form of split die is set to cut to the correct thread diameter by means of three screws: that entering the slot expands the die, and a screw on either side keeps the die from opening too far. Some of the types of dies in common use were illustrated in Fig. 5, and it follows that the fixing-screws must be located in accordance with the variety of dies used. Nevertheless, the scheme for placing the fixing-screws, illustrated in Fig. 21, should enable the die holder to accommodate most makes of circular dies. In the Pratt & Whitney and the Warrior brands of dies a central screw engages in the radial die slot, and two additional screws, lying opposite to one another, enter corresponding slots machined in

\*Continued from page 776, "M.E.", June 14, 1951.



	a	b	c	d	e	f	g
A	$\frac{5}{32}$ "	$\frac{5}{32}$ "	$\frac{3}{32}$ "	$\frac{7}{64}$ "	5 BA	$\frac{5}{32}$ "	$\frac{5}{16}$ "
B	$\frac{3}{16}$ "	$\frac{9}{32}$ "	$\frac{3}{32}$ "	$\frac{1}{8}$ "	4 BA	$\frac{3}{16}$ "	$\frac{3}{8}$ "
C	$\frac{3}{16}$ "	$\frac{11}{32}$ "	$\frac{3}{32}$ "	$\frac{1}{8}$ "	4 BA	$\frac{3}{16}$ "	$\frac{3}{8}$ "



	a	b	c	d	e	f
A	$\frac{3}{16}$ "	$\frac{5}{32}$ "	$\frac{1}{16}$ "	5 BA	$\frac{5}{32}$ "	$\frac{5}{16}$ "
B	$\frac{1}{4}$ "	$\frac{1}{4}$ "	$\frac{1}{16}$ "	4 BA	$\frac{3}{16}$ "	$\frac{3}{8}$ "
C	$\frac{1}{4}$ "	$\frac{5}{16}$ "	$\frac{1}{16}$ "	4 BA	$\frac{3}{16}$ "	$\frac{3}{8}$ "

Fig. 20. Dimensions of the clamp-screws and their housings

the rim of the die. The British type of die, however, is usually secured by means of a central screw, with the two additional fixing-screws placed at an angular interval of 90 deg. Either of the centrally-placed screws will serve for holding the Card pattern of die, but, here, the dimple for the point of the single fixing-screw is located a little above the centre-line of the die, and it is best, therefore, to drill and tap two holes for the

lugs have been set to lie horizontally, a V-tool mounted on its side at centre height is used to scribe a fine reference line across the face of the holder.

The indexing is carried out by mounting a 40 T. change wheel on the tail of the mandrel, and then securing a detent on the quadrant to engage the wheel teeth. In this way the drilling centres can readily be marked-out at angular intervals of

45 deg. and 90 deg. in relation to the scribed reference line. The cross centre-lines are next scribed with the jenny calipers at the correct distance above the face of the die seating. As shown in Fig. 23, the screw holes can be drilled by securing the casting to an angle-plate resting on the drilling machine table. The central hole is drilled with its reference line set vertically or with the handles lying horizontally; one handle is, if necessary, removed and the casting is then rotated as required to bring the remaining drilling centres, in turn, vertically under the drill.

As already mentioned, drills are apt to wander when machining this material, and a deep centre hole should, therefore, be drilled before the tapping-size drill is entered; in addition, to prevent the formation of burrs, the mouths of all the screw holes should be opened out to the clearing size for a short distance.

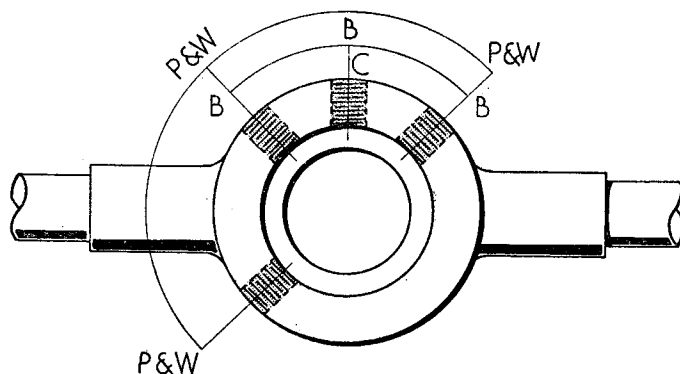


Fig. 21. Fixing-screw positions: "P & W"—for Pratt & Whitney and Warrior dies; "B"—for most British dies; "C"—for Card dies

fixing-screw at different levels, so that the die can be mounted either side uppermost in the holder. In order to ensure that the fixing-screws are correctly spaced, the outer surface of the die holder is indexed in the way shown in Fig. 22.

For this purpose, the work is gripped by the skirt of the collet housing and, after the handle

It will save time and ensure accurate threading if the drilled holes, while still in position, are tapped by mounting a tap in the drill chuck and then turning the machine by hand. Finally, the burrs formed on the inner surface of the housing are removed with a hand scraper to allow the die to fit in place. The fixing-screws them-

### The Guide Collets

Although the collets, by guiding the die on the work, are subjected to wear, it will, nevertheless, be found that even if made of soft material the guides will last quite well, and brass will usually prove satisfactory, at any rate, for making the smaller sizes of collets. However, the burrs

set up at the finish of the thread tend to score the collet as it is lifted from the work; for this reason, steel may be preferred, but case-hardened steel collets are apt to leave a spiral score mark on finished parts. The diameter of the collet bore should allow a small working clearance, and this will enable the guide to be used on round material that is slightly oversize.

As the purpose of the collet is to guide the die correctly, it is important that the bore should be concentric with the outside diameter. In the smaller size collets, this is, perhaps, best ensured by first turning the outside diameter and then forming the bore with a D-bit started in a true-running hole; the larger guides should be turned to size and then drilled, before the bore is machined to the finished size with a small boring tool.

It will be seen that the collet is shown in the drawing as being counterbored, so that only the

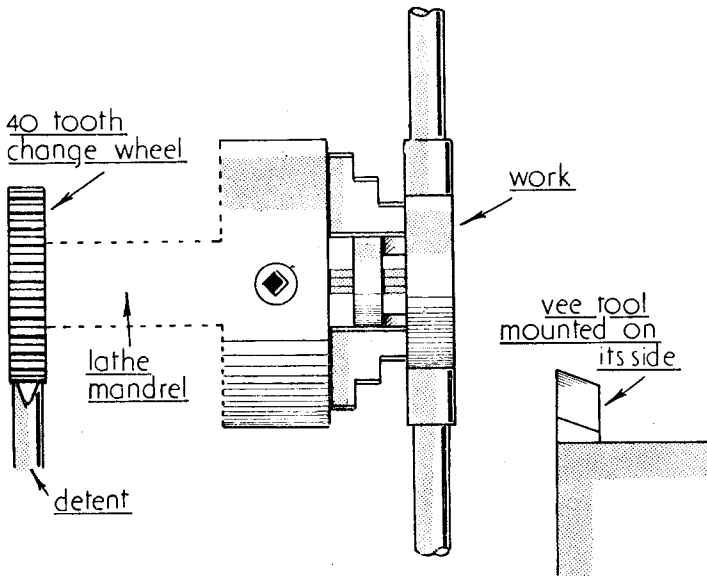


Fig. 22. Locating the fixing-screws

selves may be made of silver-steel and then hardened and tempered, but if mild-steel is used the screws should be case-hardened in order to resist wear.

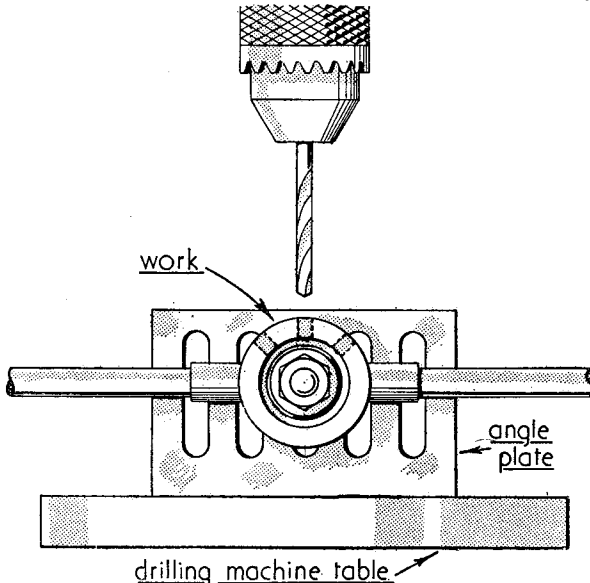
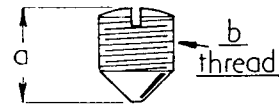


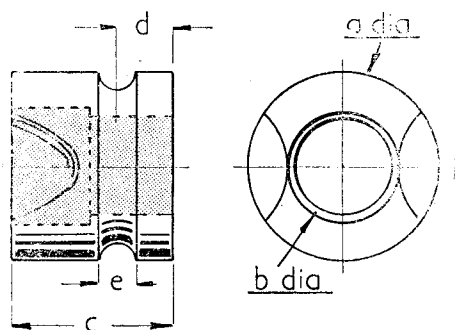
Fig. 23. Drilling the fixing-screw holes



	a	b
A	1/4"	2BA
B	1/4"	2BA
C	5/16"	1/4" BSF

Fig. 24. The fixing-screws

end portion of the bore comes into contact with the work and guides the die. As has already been mentioned, faulty dies are sometimes found with the threaded bore formed eccentrically; and if a die of this kind were used with a collet having a uniform, parallel bore, the die would then tend to cut a thread of less than the nominal diameter.



	a	b	c	d	e
A	1/2"	NOMINAL DIA PLUS .0002"	7/16"	5/32"	1/8"
B	3/4"		9/16"	3/16"	5/32"
C	7/8"		13/16"	9/32"	3/16"

Fig. 25. The collet dimensions

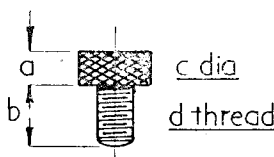
On the other hand, where the collet gives guidance at its lower end only, an eccentric die will be tilted on the work but will cut a thread of the full diameter. When cutting a thread on the short shouldered end of a shaft, a guide collet fitting the larger diameter of the work can often be employed, or sometimes the collet housing itself will serve as a guide. Again, in some instances, it may be found an advantage to use a short form

of guide that can rise in the collet housing on meeting a shoulder formed on the work. With the three sizes of colleted die holders available, no difficulty should be experienced in threading the ends of all sizes of small, shouldered shafts.

The swarf-ways in the collet are easily cut with a round file, and their shape and depth must be arranged so as to give a free exit for the cuttings. The unmachined surfaces of the castings are smoothed by filing and then finished with a strip of abrasive cloth.

Bronze is so readily filed, if a new file is used, that very little extra work will be required to obtain a good finish.

It has been found, however, that a most workmanlike finish, of quite professional appearance,



	a	b	c	d
A	5/32"	1/4"	1/4"	6BA
B	5/32"	5/16"	5/16"	4BA
C	5/32"	5/16"	3/8"	2BA

Fig. 26. The collet securing screws

is given by sand-blasting the casting. This process quickly removes all file marks and leaves a pleasing, matt surface on the work. As the result of some experimenting, a most successful sand-blasting apparatus has been constructed, and a description of this appliance will be given in a later article, together with full constructional details.

## The Bookworm Filing System

We have been favoured with a sample of the Bookworm File which provides a very handy means for filing a periodical in such a way that it can be kept in order, neatly and conveniently on a bookshelf, yet always ready for immediate reference. The one we have is of the right size for *THE MODEL ENGINEER* and has the title "Model Engineer" printed on the back.

The file consists of a stiff, glazed manilla cover containing punched adhesive bindstrips

for fixing to the edge of each issue of the periodical; these bindstrips build up a rigid back and they ensure that the periodical can be opened out flat at any desired page. A length of tagged, systoflex-covered wire is provided for lacing the issues together, but any issue can be removed, if desired, at any time without damage.

This is certainly an ingenious system, and our experience with it fully confirms all that its producers claim for it.

# TEST REPORTS

Some expert comments upon items submitted by the trade

## The Record Sheet Metal Cutter

THIS tool was submitted for inspection and test by Messrs. C. J. Hampton, the manufacturers of the well-known Record vices and other articles of workshop equipment. The appliance is designed to cut sheet-iron and steel, including annealed stainless-steel, and other sheet metals up to a thickness corresponding to 16-s.w.g. or approximately  $\frac{1}{16}$  in.

required and can be removed. For gripping the tool in this way, the body is furnished with a clamping lug.

Before any work is undertaken, it is important to make sure that the cutting wheels are correctly adjusted in accordance with the instructions issued by the manufacturers.

When the appliance is used as a portable sheet

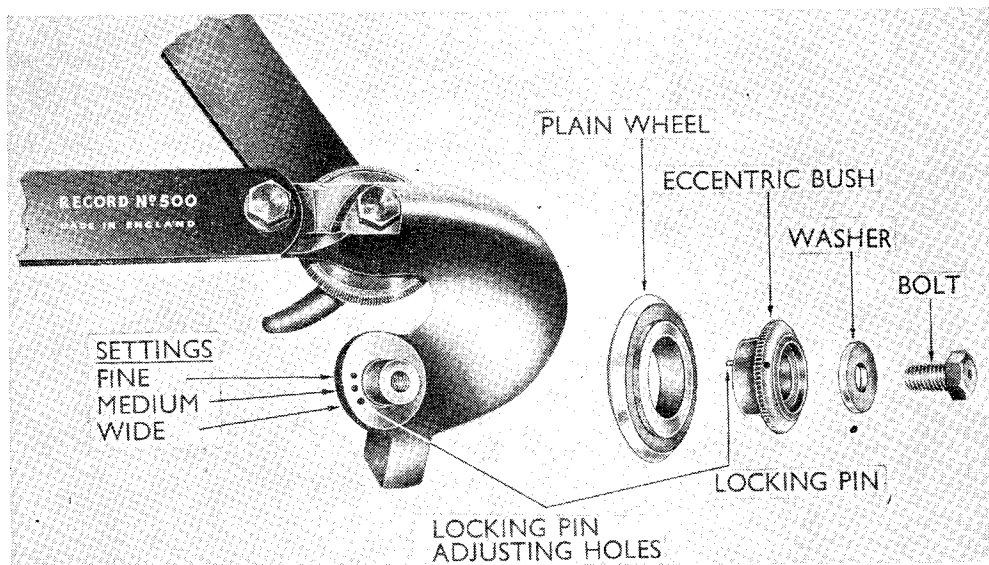


Fig. 1. Showing the construction of the appliance

The work-head of the tool consists of a heat-treated, high-tensile steel casting which has two axles for carrying a pair of cutting wheels, mounted on hardened steel bushes. As shown in the illustration, one of these wheels has a plain cutting edge and the other is serrated. The lower bush, carrying the plain wheel, is machined eccentrically so that the position of the cutter can be adjusted to accommodate material of various thicknesses. The upper wheel, by means of its serrated edge, tends to draw the sheet material between the two cutting wheels. As will be seen in the photographs, two long handles are attached to the work-head so that the lower can be used to guide the appliance whilst the upper rotates the serrated cutting wheel. When the tool is held in the vice to serve as a bench shear, the guide handle is not

metal cutter, sheets of moderate size will clearly, have to be secured to the bench with clamps or held by an assistant, for one hand is needed to guide the tool and the other to work the operating handle. The makers point out that the clamping lug should be gripped at the right of the vice, and that the upper surface of the lug should be set level with the surface of the vice jaws. As will be seen in the illustration, this clamping lug is short and so will be gripped by one end only of the vice-jaws; this method of holding would seem to throw a rather heavy twisting strain on the moving parts of the vice, and it might, therefore, be advisable to use a compensating distance-piece at the other end of the vice-jaws. A convenient form of distance-piece, made equal to the width of the lug, is illustrated in Fig. 4, and when this fitting is

placed between the vice-jaws the appliance will be firmly held without having to tighten the vice excessively.

The plate attached to the upper surface of the block holds the distance-piece in place while the cutter is being clamped in the vice; this plate should, however, be made of thin sheet material so as to stand as little as possible above the surface of the vice jaws.

The tool appears to be well-made and is finished in a serviceable manner with nicely fitted wooden hand grips at the ends of the two levers. The abutment face on the casting for the upper wheel is, however, rather irregularly machined, and this may account for the movement of the lever being stiff in one position and a little slack in another. The upper wheel bush appears to have been finished by hand grinding, for there are flats on the bearing surface, and this portion of the bush is out-of-round and slightly tapered. The abutment face for the lower wheel shows

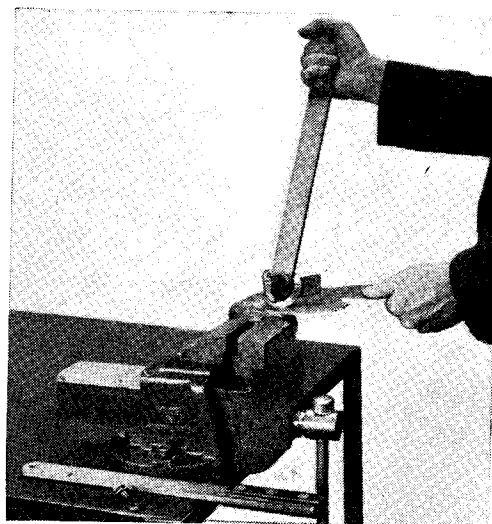


Fig. 3. Using the tool as a bench shear

as with a good pair of the more familiar tinman's shears. Moreover, a narrow strip of material is apt to become curled and deformed as it is cut off, and the serrated wheel tends to leave a corresponding series of indentations on the work.

The tool certainly has one great advantage over the ordinary hand or bench shears, in that a

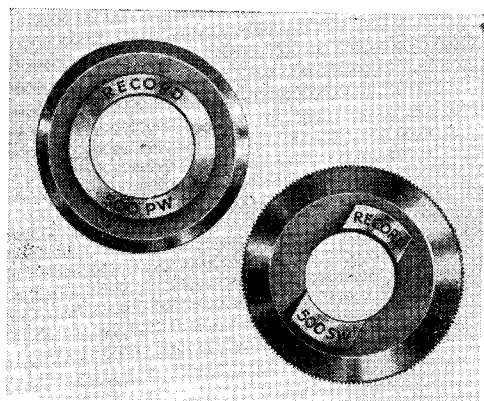


Fig. 2. The plain and serrated cutting wheels

chatter marks, and the bush itself might well be more highly finished. By contrast, the actual cutting wheels were found to be well and accurately finished, and there should be no difficulty when it comes to fitting new wheels.

It is fully realised that, with the present high cost of labour, time cannot be spent economically in giving a high finish to parts that are not directly concerned with the efficient working of a manufactured tool. Moreover, a high general finish is not appreciated by all users, and by commercial concerns may be regarded as an unnecessary expense.

On the other hand, the surface finish and close fitting of working parts cannot rightly be neglected in tools of good quality, for these factors may be essential to ensure proper working as well as good wearing qualities. Where advantage is taken of modern methods of finish-grinding, accuracy and interchangeability of components are readily ensured.

When the tool was tried on a piece of sheet steel, the impression was gained that a little practice would be required before straight and even cutting could be carried out as effectively

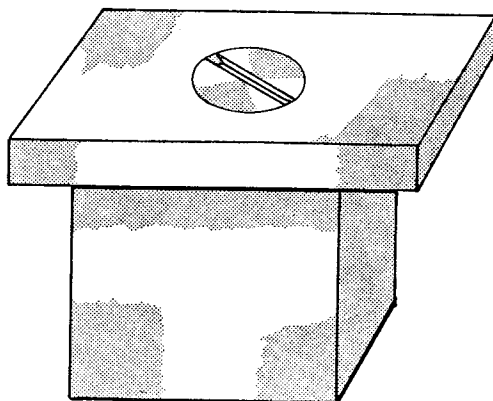


Fig. 4. A distance-piece for use in the vice jaws

vertical cut can be carried right up to a mark and with but little danger of over-running the required distance. Furthermore, the appliance cuts freely along a curved line, and does not score the edges of the work, as may happen with ordinary straight-bladed shears. Nevertheless, the makers warn the user against forcing the cutters along a curve of small radius. For the sheet-metal worker who has to undertake a wide variety of both linear and curved cutting, this tool should be of great service, once, after a little practice, full mastery has been gained.

# Queries and Replies

*Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed: "Queries Dept.," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.*

*Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.*

*More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.*

*Where the technical information required involves the service of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.*

*Only one general subject can be dealt with in a single query; but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.*

## No. 9913.—Hot-air Engine Cylinder G. T. (Dukinfield)

**Q.**—I have in my possession a hot-air engine, minus con-rod and piston for the large cylinder. Not being familiar with these engines, I should be pleased if you would inform me as to the type and size required, also the material used.

**R.**—The piston for the large cylinder referred to is not intended to be an actual fit in the cylinder, but to act as a displacer so as to shift the air from one end of the cylinder to the other. It should, therefore, be made about  $\frac{1}{16}$  in. smaller than the cylinder, and should preferably be made hollow. Its length should be such that it approaches fairly closely to the ends of the cylinder at each end of the stroke. This piston should be fitted with a rigid rod to work through a close-fitting guide bush in the mouth of the cylinder, which acts as a crosshead, and a short connecting-rod with a knuckled joint is used to attach it to the crankshaft. In case the crankshaft of your engine is not positively fixed for timing, the displacer crank should be timed about 90 deg. ahead of the main piston. The action of this type of engine is as follows: when the displacer is at the front or cooled end of the displacer cylinder, the air is forced into the hot end of the cylinder and thereby caused to expand, producing pressure which operates on the smaller piston to drive the engine. In doing so, the position of the displacer is then shifted to the other end of its cylinder, so that the air is displaced to the cold end, and thereby caused to contract. This results in a reduction of pressure, which draws the smaller piston back into the cylinder. It is most important in a hot-air engine that leakages, either past the piston or the guide-bush in the displacer, should be eliminated as far as possible, otherwise the engine will not work at all. Good lubrication is essential, but very thin oil should be used to avoid oil drag.

## No. 9921.—Reducing the Power of a Motor D. F. L. (Mirfield)

**Q.**—Could I make a  $\frac{1}{2}$  h.p. motor into a  $\frac{1}{4}$  h.p., in effect by reducing the input to it, say, by using a series choke or condenser? The motor is correct, for the supply voltage, being: 220-230 V, 50 cycle, 1-phase,  $\frac{1}{2}$  h.p., 1,425 r.p.m., split-phase, 3.39 A. A  $\frac{1}{4}$  h.p. motor would be adequate for the bulk of our work. Much of the turning is very light, even for a 4-in. lathe. I would incorporate a switch so that the added reactance could be conveniently cut in and out as required. If you agree that my suggestion is worth trying, what reactance would you advise? Presumably a capacitor would be better than a choke, for power-factor reasons.

**R.**—It is not practicable to reduce the h.p. of your motor on the lines you have in mind. What you would actually do, would be to reduce the voltage to the machine. Under these conditions it is possible that it could not be started, and under running conditions, its speed could vary over a load and probably pull out of step. The only solution is to rewind for a  $\frac{1}{4}$  h.p. output. There would be no point in doing this however. If you require your motor to start without the quick start, the condenser could be dispensed with but before doing this, make sure that the starting winding is designed to work on the full supply voltage. It is possible that this winding may be tapped on one half of the running winding. In this case, only half-line volts are applied to the starting winding through a suitable condenser or other form of choke. No account is taken of power factor, so far as the meter is concerned, it will measure the energy used. Correcting the power factor will help to reduce the wasteful currents that have to be provided for from the generating end, and also reduce the current taken by any piece of apparatus, which are taken into account by the meter.

# PRACTICAL LETTERS

## An Early "Fowler"

DEAR SIR,—With reference to the illustration in "Smoke Rings" for December 14th, and the letter from the Rev. R. C. Stebbing concerning it, I can confirm that the three-wheeled road locomotive shown is in fact a Fowler.

At the Wolverhaston Show of the R.A.S.E. in 1871, Fowlers exhibited four three-wheelers, two of which were of 12 horsepower and two of six horsepower. One of each power was fitted with the Aveling and Greig rubber-tyred wheels, as on the photograph, and the others had "normal" wrought-iron wheels.

The confirmation, however, is in illustrations in *The Engineer* and *Engineering*, both of July 7th, 1871; the former shows the 12 h.p. engine, and the latter the 6 h.p. Both are identical in appearance with each other and with the engine in Mr. Ball's photograph, and thus all doubts are resolved as to the identity of the latter.

Yours faithfully,  
W. J. HUGHES.  
Sheffield.

## Fitting Scroll Chucks

DEAR SIR,—I should like to comment on Mr. Usmar's article in your May 17th issue. On many occasions in past years instructions have appeared to help the inexperienced over this hurdle and so far as I can see the writers of these seem, without exception, to assume that it is more important to achieve a tightly fitting backplate spigot than a true-running job in the lathe.

It may be, of course, that modern self-centring chucks are of a super brand that are perfectly concentric and will remain so, but I doubt it, and if not the attitude seems an odd one to me but is doubtless good enough for the rough and ready user who asks no more of his chuck than to hold his material approximately centred within 5 or 10 thou. or so and indeed for factory conditions where, however, more likely than not, soft jaws capable of being trued up as required will be in use. It would not be good enough for me, however, nor, I fancy, for any model engineer taking a pride in doing good and accurate work.

Provided that a scroll chuck hasn't been badly strained or otherwise misused, it is not difficult to make it hold work perfectly truly, and still more important to the model maker, to rechuck already turned articles quite accurately for second operation work, but to do so the user must get away from this fetish of the tightly fitting backplate.

I keep two 3-in. scroll chucks in use on my lathe, outside jaws in one, inside jaws in the other, changing over at intervals. One has had over 30 years use and the other just under 40 and I expect them both to carry cylindrical material well within 0.001 in. of dead concentricity by indicator test throughout their range and within 0.0015 in. at, say, 1 in. out from the jaws, and any other small lathe user can get the same service from his chuck if he likes to take the trouble. It must not, however, be supposed that it will do this throughout its range at the same setting; scrolls always wear unevenly.

The way to do it is simplicity itself and was used by skilled instrument makers before I was born. Give sufficient clearance to the backplate spigot and in the holes for the chuck-holding screws to allow about 1/32 in. all-round movement of the chuck body on the backplate itself. When a job runs out of truth it is a matter of moments to ease back the holding screws, set the chuck and job over together as a unit, and tighten up again. I hope this ancient tip, which I last gave in the "M.E." some 16 years ago, will help some who find difficulty in contending with a self-centring chuck that will not centre.

Yours faithfully,  
WM. T. BAXTER, S.M.E.E.  
Blackheath.

## "Britannia"

DEAR SIR,—I was greatly interested in the letter from Mr. C. M. Keiller about the new 70000 class locomotive, as I am of the same opinion about it myself.

Writing purely as a layman, but as one who has made a study of the mechanical layout of most types of locomotives running in this country, I should have thought it possible to "sort out" from existing types a sufficient number capable of carrying out all that is required in this small island of ours.

Of course, we must always strive to progress, but the new locomotive does not appear to me to have anything "new," or "novel," or even anything in its make-up, which is likely to improve greatly its efficiency or general availability as compared with some existing types.

I do not think, except perhaps for real high speed express work, that a "Pacific" is at all necessary; after all, the G.W.R. managed without them for long enough and even on the L.M.S. the majority of expresses were worked by 4-6-0's. The exception, of course, was the L.N.E.R. which will always be remembered as a "Pacific Line."

If it is purely simplicity, availability and reliability that is required, then surely we had all these qualities, coupled with a very good all-round performance in the Stanier Class "5."

My own selection would have been made as follows:—

Express duties, A/3 or A/4, modified "Scot," "Castle."

Medium Express and General Passenger, Class "5," "V2" and Stanier 2-6-4 tanks for suburban and short haul duties.

Mineral and Goods, "Stanier" 2-8-0, no other required.

Shunting and General Work, G.W.R. "Pannier" and L.M.S. Class "3" tank.

Having selected these I should have proceeded to have a sufficient number of the "big uns" overhauled and brought back to original condition and performance; these would then be used for "top link" duties only and nothing else.

Pleasant dreams, but then I am not the C.M.E. or ever likely to be.

Yours faithfully,  
D. A. SPROSON.  
London, N.W.9.

**Emett Locomotives**

DEAR SIR,—Mr. Bostel's model of an Emett locomotive, illustrated in THE MODEL ENGINEER for April 26th, is quite the best that has been seen so far, but it still fails utterly to bring out the spirit of the prototype.

These engines are obviously not made by engineers. They do not have fine clearances and seven-flued superheaters to help them drag heavy loads with deep-throated efficiency; their purpose is to convey a lady and gentleman of the utmost refinement from a gleam of sunshine to the next cup of tea!

They are thrown off casually by silversmiths between a pair of period candlesticks and a coffee-pot. Their chimney is beaten from a

single sheet and flares gracefully at the top, while the boiler has a charming sag in its middle. The water enters the boiler from the high-sided tender under its own head, needing no fancy injectors to overcome such pressure as there may be.

The buffers, especially, are half as long as the engine, and have an enquiring, almost prehensile air, as though they would shake you by the hand.

All the models I have seen do more damage to the original than was done to the Oysterbay Special when, inadvertently, it took the loop-line through Witches' Hollow on a Christmas Eve. Do let us have more REALISM!

Yours faithfully,  
Slough. L. BARNETT.

## CLUB ANNOUNCEMENTS

**Derby Model Racing Club**

The above club are holding their annual regatta on July 1st, at Allestree Park, Derby, starting at 2 p.m., when the following events will be run:—

- 500 yd. race for Class "A."
- 500 yd. race for Class "B."
- 500 yd. race for Class "C"—Rolls-Royce Trophy.
- 500 yd. race for Class "C" restricted—Derwent Shield.

**The Edinburgh and Lothians Miniature Railway Club**

The Inaugural Meeting of this club will be held in the Edinburgh Chamber of Commerce, 25, Charlotte Square, Edinburgh, 2. On Friday, July 6th, 1951, at 7.30 p.m.

All those interested in miniature railways, resident in the city, the Lothians or neighbouring counties are urged to attend and support the new and long overdue society. Those willing to join, but unable to attend, are requested to write to Mr. W. Loch Kinston, 6, Chester Street, Edinburgh 3. S.A.E. please

Good club premises are being negotiated for.

**The Tees-Side Society of Model and Experimental Engineers**

At a meeting held at headquarters recently, members were privileged to hear a very practical talk on "Brazing and Silver-Soldering" by Mr. Norman Reed, who produced articles which were illustrative of such work.

Headquarters address: 400, Linthorpe Road, Middlesbrough.

Hon. Secretary: J. W. CARTER, 28, East Avenue, Billingham.

**North London Society of Model Engineers**

At the monthly meeting held at the offices of the Eastern Gas Board, Station Road, New Barnet recently, the members were treated to a most interesting lecture on "Ships and many things," by Commander Crane ("Jason").

His anecdotes on Sailing Ships and Paddle Boats included many highly amusing and instructive items. Though indisposed, he gave his lecture under difficulties.

Hon. Secretary: W. W. RANSOM, 14, Betstely House, 197, Colney Hatch Lane, N.10.

**The Orpington Model Engineering Society**

On Sunday, June 10th, this society were the guests of Hastings and District Model Engineers Society. The Orpington members travelled by coach, complete with powerboats in the boot, and were received at Alexandra Park by the Hastings society. An informal regatta then took place, with Mr. Hodges giving the fastest time of the day with his 15 c.c. boat *Spartan II*. Messrs. Cluse, Gable, Whiting and Ward then gave demonstrations, the latter giving an interesting show of his new boat *Kali*. Unfortunately, *Kali* did not complete the full number of laps, but what there was, was good!

What with the excellent weather, and the magnificent hospitality provided by the Hastings society, the visitors returned with memories of a very happy day.

Turning to the future, interested readers are warned to get their boats ready for Orpington's regatta, which will be held at Victoria Park on Sunday, July 1st, with the kind co-operation of the home club.

Hon. Secretary: W. FRYATT, 68, Wellington Road, Orpington. Tel.: Orpington 7903.

**Eltham and District Locomotive Society**

The next meeting will take place at the "Bee-Hive" Hotel, Eltham at 7.30 p.m. on Thursday, July, 5th which will be a Workshop Discussion night organised by the chairman, Mr. Hutton. Members are asked to bring along their problems for solution. At the last meeting the Rummage Sale proved successful, several tools and material being disposed of. Mr. Phillips and Mr. Finn who attended as visitors seemed to be the most prominent customers.

The society are now busy with their portable track runs, at fetes and sports days, and in spite of the weather on two occasions "live steam" kept going. Mr. "Pop" Crampton and Messrs. Powell proved that rain doesn't stop locomotive enthusiasts or children that are determined to have a ride. Visitors are always cordially invited to the meetings.

Secretary: Mr. F. BRADFORD, 19, South Park Crescent, S.E.6.

**Hastings and District Model Engineers Society**

A very pleasant day was spent on June 10th when the society had as visitors members of the Orpington Model Engineering Society and Eastbourne Model Powerboat Club. The day was sunny though a little breeze made the Steering competition on the Alexandra Park pond a rather difficult affair.

The proceedings did not start until 1.0 p.m.: from then until 3.0 o'clock the Steering competition was held. Nobody exactly shone in this, and out of a maximum possible total of 15 points only one boat was awarded 6 points, one boat 4 points and two boats 3 points. From 3.0 until 4.30, Round the Pole racing was held and several Orpington boats did very well, though the pond was a little choppy. Top speed was 40.11 knots, and, it was unfortunate that one of the Orpington boats, a 30 c.c. job, had not been run-in, otherwise we would have seen a much higher top speed for the afternoon. In all, about 20 boats took part.

A party of 62 members and visitors then went to the White Rock tea rooms for tea, after which a short speech of welcome to the visitors was made by our chairman, A. P. E. Foote. The home clubs powerboat section leader T. Bridge-land said it had long been his ambition to see what he had seen in the afternoon—the pond in Alexandra Park filled with boats. In replying, the chairman of the Orpington society thanked the home club for putting on a very pleasant day.

After tea the visitors were taken to the outdoor car track at Pebsham, where members of the race car section had some 10 cars operating. Speeds of up to 90 m.p.h. were recorded by J. Pitt with his Powell powered 10 c.c. car. Mr. Elliott's scale 6-cylinder Maserati did the quarter of a mile at 69 m.p.h., other speeds were Mr. Marshall's twin cam Austin 81.83 m.p.h., Mr. Smith's B.R.M., 85 m.p.h., Mr. Smith's Ferrari 85 m.p.h., and Mr. Elliott's 2½ c.c. Special 59 m.p.h.

At a recent meeting, a member, J. R. Walker, A.M.I.E.E., gave a talk entitled "Tunnelling under the Thames." Explaining the many scientific calculations which must be made before such an undertaking is begun, he also showed the many dangers attached to it, in particular the alternating pressures when working under the water, being due to the rise and fall of tide in the river above. He recalled some amusing incidents and some rather serious ones.

Hon. Secretary: W. BROGAN, 4, Mount Pleasant Road, Hastings.